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COONEY DAM

MANUAL FOR OPERATION AND MAINTENANCE

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**State Water Projects Bureau
Water Resources Division
Department of Natural Resources and Conservation
48 North Last Chance Gulch
P.O. Box 201601
Helena, Montana 59620-1601**

**Initial Publication 1983
Revised August 2001**

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OVERVIEW

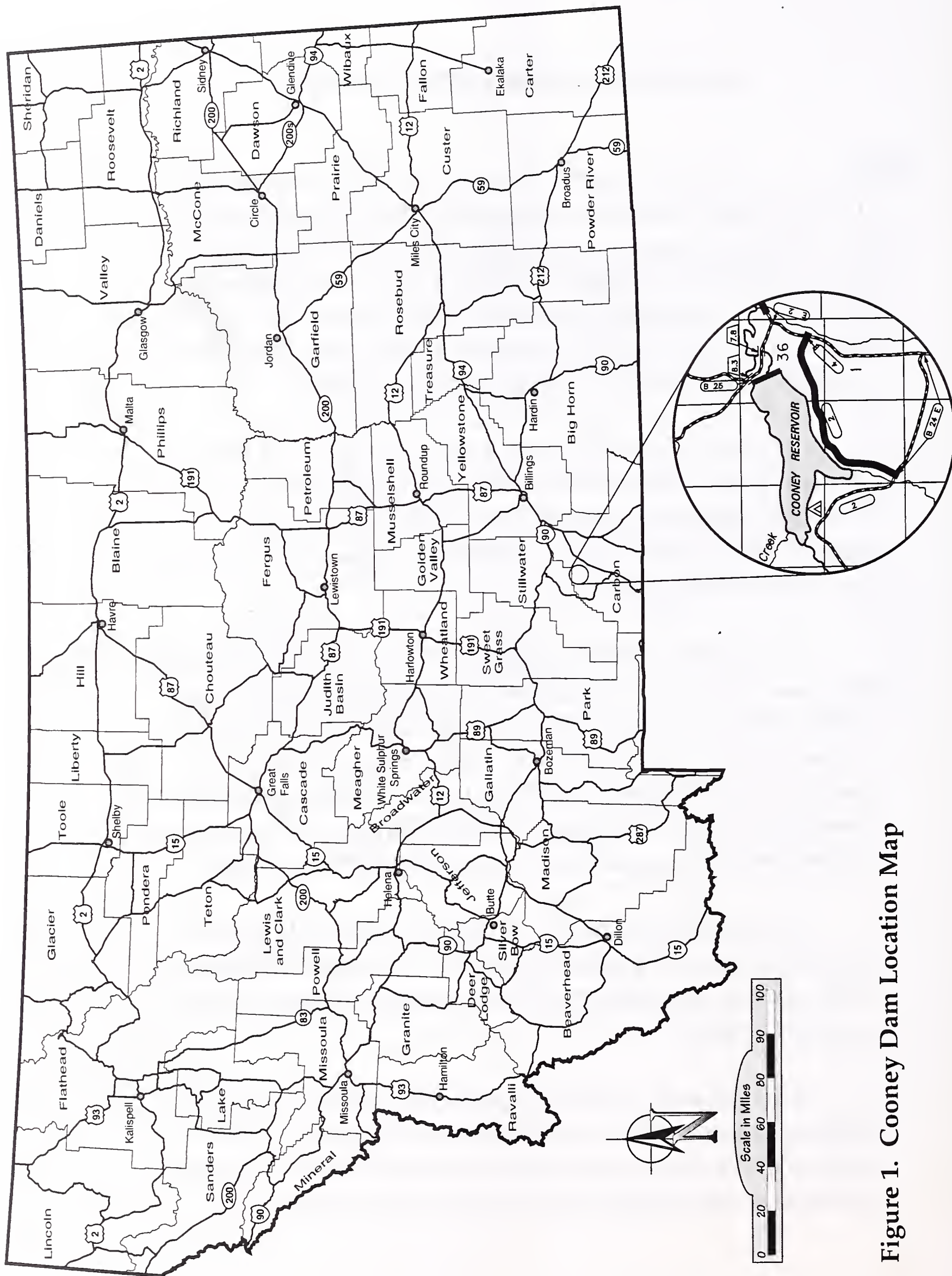
Cooney Dam and Reservoir are located in Carbon County about 7 miles west of the town of Boyd, Montana (Figure 1). The dam is located on Red Lodge Creek. The reservoir is fed by Red Lodge Creek and Willow Creek, and water is also obtained from Glacier Lake Reservoir (Figure 2). Figure 3 provides a general layout of the dam, spillway and outlet works. Figure 4 provides a diagram of the drains in the right abutment manhole.

The dam is owned by the Montana Department of Natural Resources and Conservation (DNRC) and is managed by the State Water Projects Bureau (SWPB) of the DNRC. The Rock Creek Water Users Association (herein called the “association”) operates and maintains the dam.

The earthfill dam was completed in 1937. In 1982, the dam was raised 5 feet and rehabilitated to comply with current dam safety standards. The rehabilitation included raising the dam embankment 5 feet, replacing the principal spillway, adding a guard dike in the spillway approach channel, adding a fuse plug emergency spillway, replacing the wooden bridge over the principal spillway with a concrete bridge, and adding additional drains.

The earthfill dam is 102 feet high and impounds 28,230 acre-feet of water at the guard dike crest. The dam contains an outlet conduit with operating gates, a principal spillway, and an auxiliary spillway.

Water from the reservoir is primarily used for supplemental irrigation water supply on approximately 20,000 acres. Some benefits also accrue to water-based recreation and flood control, although no specific allocations to these uses currently exist.



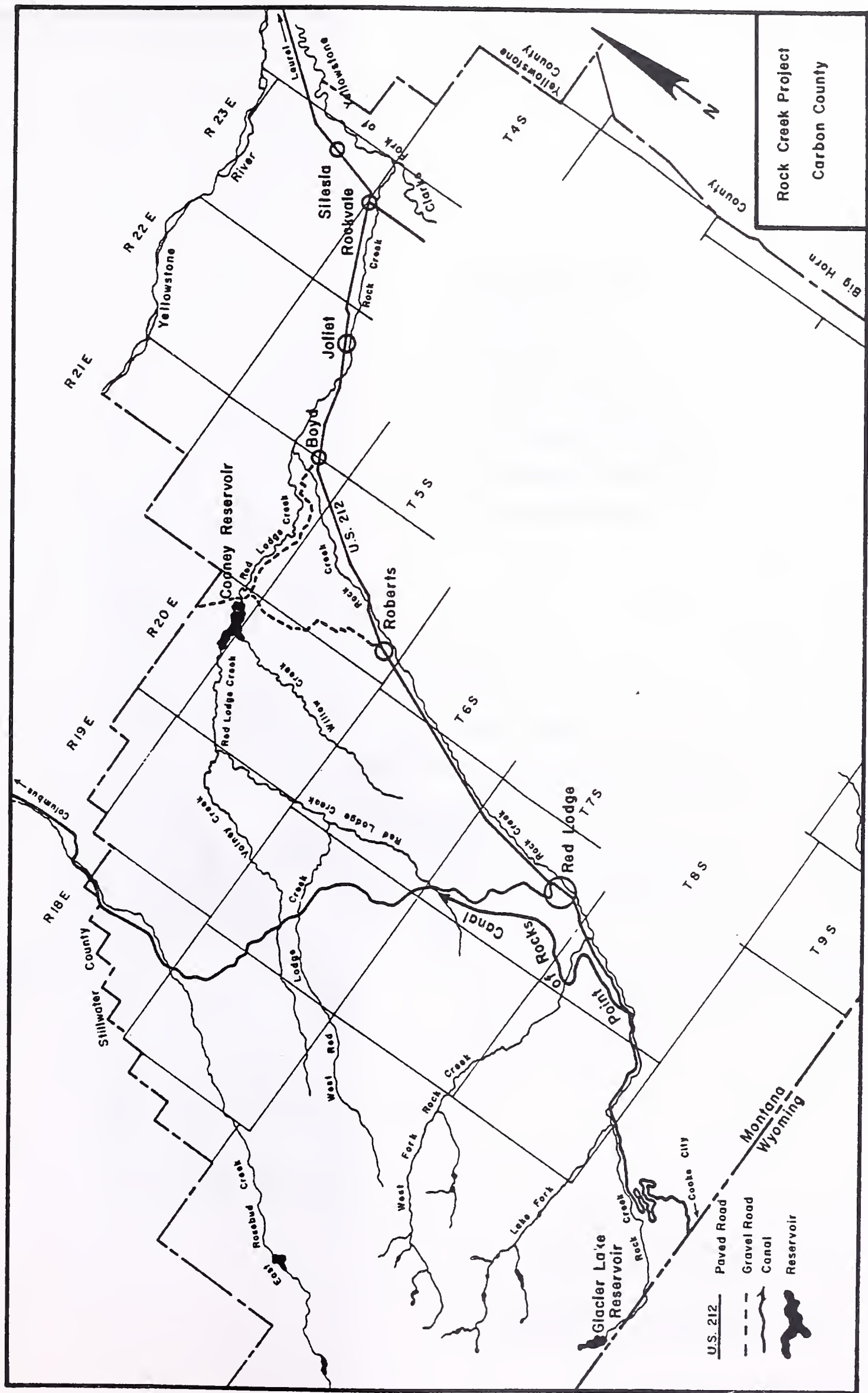
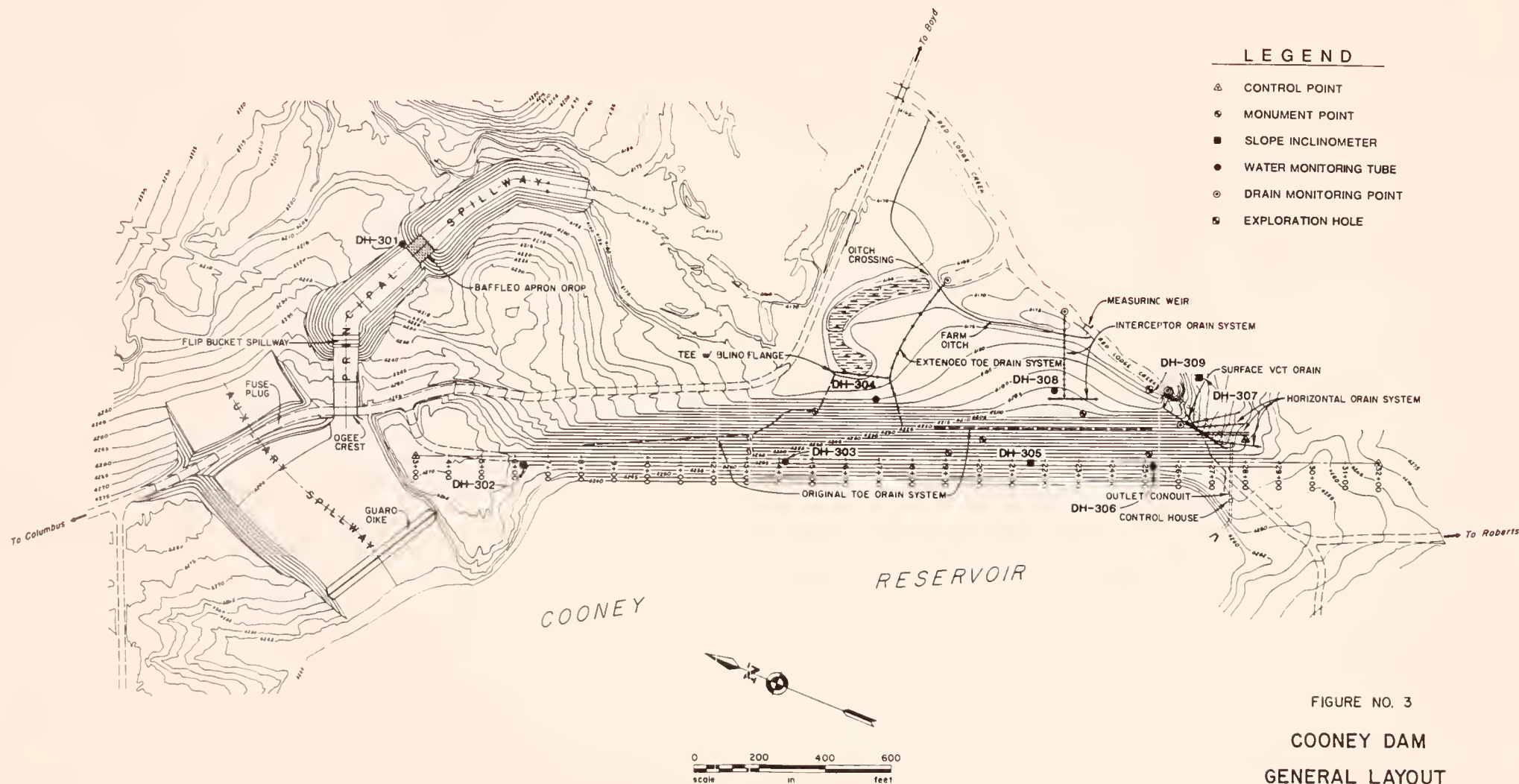


Figure 2. Rock Creek Project



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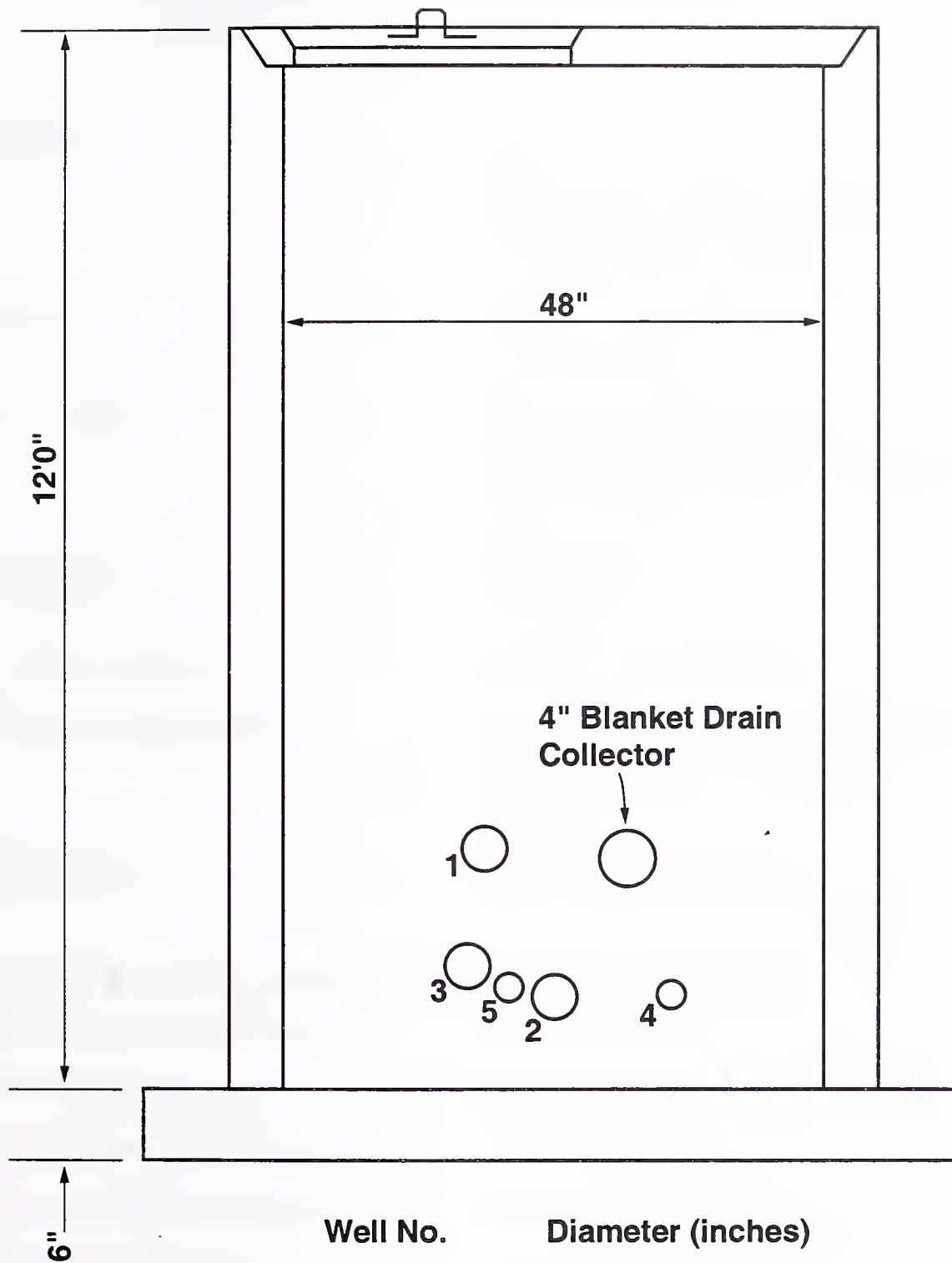


LEGEND

- △ CONTROL POINT
- ⊙ MONUMENT POINT
- SLOPE INCLINOMETER
- WATER MONITORING TUBE
- ⊙ DRAIN MONITORING POINT
- ⊞ EXPLORATION HOLE

FIGURE NO. 3

COONEY DAM
GENERAL LAYOUT



Well No.	Diameter (inches)
1	3
2	3
3	3
4	1 1/2
5	1 1/2

Inside Manhole Inlet View of Wells

Figure 4. Right Abutment Drain Numbering

STATISTICAL INFORMATION

1. General

a. Owner	Montana Department of Natural Resources and Conservation (DNRC)
b. Operator	Rock Creek Water Users Association
c. Location	Sections 25 and 36 Township 4 South, Range 20 East MPM
d. Latitude	45.45°
Longitude	109.20°
e. County-State	Carbon - Montana
f. Watershed Location	Red Lodge Creek and Willow Creek, Yellowstone River Basin
g. Drainage Area	206 square miles

2. Principal Elevations (feet above mean sea level)

a. Maximum Dam Crest	4,267.0 feet
b. Settled Dam Crest	4,265.0 feet
c. Maximum Surcharge Pool	4,263.0 feet
d. Emergency Spillway Crest	4,254.15 feet
e. Normal Full Pool	4,251.0 feet
f. Guard Dike	4,251.0 feet
g. Principal Spillway Crest	4,247.25 feet
h. Outlet Design Invert	4,175.0 feet

3. Reservoir

- | | |
|--|----------------------------|
| a. Length of Pool
(approximate) | 2.5 miles |
| b. Maximum Reservoir
Level of Record | 4,252.2 feet (May 9, 1988) |
| c. Surface Area
(at normal full pool) | 1,078 acres |

4. Storage

- | | |
|---|------------------|
| a. Maximum Surcharge Pool
(at elevation 4,263 feet) | 40,100 acre-feet |
| b. Total Storage
(at guard dike crest) | 28,230 acre-feet |
| c. Active Storage
(at guard dike crest) | 28,140 acre feet |
| d. Maximum Surcharge
(from guard dike crest to 4,263 feet) | 11,870 acre-feet |

5. Hydrology

- | | |
|--|------------------------|
| a. Inflow Design Flood
(Probable Maximum Flood) | 55,339 cfs peak inflow |
| b. 100-Year Flood | 6,010 cfs peak inflow |
| c. 100-Year Flood | 4,365 cfs peak outflow |
| d. 100-Year Elevation | 4,253.6 feet |
| e. 500-Year Flood | 9,390 cfs peak inflow |

6. Embankment (Dam)

- | | |
|---|---------------------------|
| a. Type | Earthfill |
| b. Hydraulic Height | 102 feet (settled height) |
| c. Crest Length | 2,369 feet |
| d. Crest Width | 24 feet |
| e. Downstream Slope | 1v on 2 h |
| f. Upstream Slope
(above elevation 4,245 feet) | 1v on 2.25 h |

- | | |
|--|-----------------------|
| g. Upstream Slope
(between elevation 4,245
and 4,197.6 feet) | 1v on 3 h |
| h. Upstream Slope
(below elevation 4,197.6 feet) | 1v on 7 h |
| i. Volume | 1,544,500 cubic yards |

7. Spillway (Guard Dike)

- | | |
|--------------------|---|
| a. Location | Left abutment |
| b. Type | Uncontrolled |
| c. Width | 6 inch wide reinforced
concrete wall |
| d. Length | 410 |
| e. Crest Elevation | 4,251.0 feet |

8. Spillway (Principal)

- | | |
|---|---------------|
| a. Location | Left abutment |
| b. Type | Ogee Crest |
| c. Width | 70 feet |
| d. Crest Elevation | 4,247.25 feet |
| e. Design Capacity
(reservoir at 4,263 feet) | 5,225 cfs |

9. Spillway (Emergency)

- | | |
|---|---------------|
| a. Location | Left abutment |
| b. Type | Fuse Plug |
| c. Width | 360 feet |
| d. Crest Elevation | 4,254.15 feet |
| e. Design Capacity
(reservoir at 4,263 feet) | 52,000 cfs |

10. Outlet Works

- | | |
|--------------------------|---|
| a. Size | 6-foot high by 6-foot wide
horseshoe-shaped tunnel |
| b. Length | 630 feet |
| c. Control | 5-foot diameter butterfly
control valve (operating gate)
and a 5-foot diameter guard
slidegate (emergency gate)
with manual operators |
| d. Capacity | |
| Limited by weir | 550 cfs |
| Pool at Guard Dike Crest | 900 cfs maximum |
| e. Trashrack | Yes |

OPERATING PROCEDURES

The association operates Cooney Reservoir to provide an adequate supply of irrigation water to meet contracts with water users without exceeding safe storage or flow levels.

DAM OPERATOR

The responsibility for the daily operation of the dam and reservoir rests with the association and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's goal of providing an adequate supply of contracted irrigation water without exceeding safe storage or flow levels. The dam operator's specific responsibilities are to:

1. Operate the mechanical features of the outlet works.
2. Coordinate filling of the reservoir and the release of water.
3. Notify the SWPB of unusual occurrences, such as impending floods or excessive seepage.
4. Perform various maintenance tasks.
5. Monitor weather conditions.
6. Monitor seepage.

Typically, the out-going dam operator, water users association, and the SWPB train a new dam operator. The dam operator's training focuses on the mechanical operation of the gates, measurement of the storage level, measurement of the rate of water release, and record keeping.

The dam operator normally is available to observe the dam and perform operating functions daily during the irrigation season. During the non-irrigation season, one of the officers or directors observe and regulate the dam on a monthly basis. Communication among the dam operator, the association, and the SWPB usually takes place by telephone. Although not routinely available, radio

communication may be established during emergencies or unusual occurrences, so the dam operator can speak directly with county authorities and communicate indirectly with the SWPB (see Cooney Dam Emergency Plan).

METHOD AND SCHEDULE OF OPERATION

Depending on snowpack, runoff patterns, and carryover storage, filling of the reservoir usually starts in April or May. The goal is to have the reservoir full before the main runoff has receded to a flow where all inflow must be allowed downstream to satisfy senior water rights, usually around June 15. The date irrigation releases begin varies from year to year, with late April typically the earliest. There have been years when no significant irrigation releases have been requested. Irrigation releases usually end by mid-September. The actual dates tend to vary depending on each year's actual climatological and hydrological conditions.

Simplified reservoir operating curves have been developed to assist in determining the proper outflow at the dam during a high runoff year. In low runoff years, storage will be a function of releases made to senior water right holders, and the reservoir may not fill completely. The Cooney Reservoir operating curves and directions for their use are presented in Appendix A.

Maximum Winter Storage: The maximum reservoir elevation for winter storage is 4,241.0 feet with 20,150 acre-feet of storage. This winter maximum helps prevent damage to the riprap and embankment from wind-driven waves and ice.

Minimum Winter Storage: The minimum reservoir elevation for winter storage is 4,200.0 feet with 2,540 acre-feet of storage. This winter minimum helps prevent ice damage to the inlet structure for the outlet works.

OUTLET WORKS

With the pool at the guard dike crest, the maximum capacity of the outlet works is 900 cfs. However, the maximum flow (without overtopping) of the weir downstream of the outlet tunnel is 550 cfs. Releases are limited by this factor and the safe drawdown rate.

The outlet gates are manually operated with a hand crank. The only specific concern that the dam operator need be cognizant of is the fact that the gate vibrates when it is opened to a point where approximately 12 to 15 inches of the stem extends above the top of the pedestal. The gate should not be left in this position, but rather opened more fully or closed down a bit until the vibration stops.

The maximum amount that the operating gate can be opened is 30 inches. The maximum opening for the emergency gate is 60 inches. Openings in excess of these amounts may damage a gate, gate frame, gate stem or the gate pedestal. These openings are measured on the exposed portion of the gate stem between the top of the pedestal and the bottom of the stop nut (or top of the gate stem if there is no stop nut).

The outlet works are intended to be used for controlling the release of irrigation water and not for providing emergency flood relief. Up to 900 cfs may be passed through the outlet works, but discharges in excess of 550 cfs will overtop and possibly damage the weir and could cause washing of the toe of the dam. A rating curve for the outlet works is included in Appendix B.

SPILLWAY

The dam has a principal and an emergency spillway. The principal spillway was designed to pass the peak outflow resulting from a 100-year frequency flood event. The emergency spillway

was designed to pass the peak outflow from a probable maximum flood (PMF) event. Those capacities are 5,225 cfs and 52,000 cfs, respectively. Rating curves and tables for the two spillways are included in Appendix B.

SAFE DRAWDOWN

To ensure stability of the upstream embankment, it is recommended that reservoir drawdowns do not exceed one foot per day. This recommended rate should not be exceeded without the approval of the SWPB.

The relationship between pool elevation and the flow rate that should be added to the inflow rate to determine the maximum release rate is shown as Safe Drawdown Rate Table in Appendix B. Depending on the pool elevation, the release rate should be kept below the safe rate determined or below 550 cfs, whichever is less. The relationship between pool elevation and active storage is also shown in the table.

STORAGE DETERMINATION

Storage in the reservoir and elevation of the reservoir surface are determined by taking a slope measurement. Measure in feet from the 0+00 pin, located at the upper left (southwest) corner of the boat ramp slab in the campground on the south side of the reservoir, to the water surface. The alignment follows the left edge of the slab with pins placed below the slab grade at 50 foot intervals. Once the slope distance is determined, the elevation of the reservoir surface and the storage can then be found using the Slope Distance-Elevation-Storage Table in Appendix B.

INFLOW AND OUTFLOW MONITORING

Current inflows into the reservoir and outflows from the reservoir can be found under the Yellowstone River Basin portion of the following USGS internet site:

http://montana.usgs.gov/rt-cgi/gen_tbl_pg

USGS gage 06211000, Red Lodge Creek Above Reservoir, monitors current inflows into the reservoir. The gage is located on the right bank of Red Lodge Creek 0.6 miles upstream of the reservoir. The drainage area above the gage is 143 square miles.

USGS gage 06211500, Willow Creek Above Reservoir, monitors current inflows into the reservoir. The gage is located on the left bank of Willow Creek 0.5 miles upstream of the reservoir. The drainage area above the gage is 53.3 square miles.

USGS gage 06212500, Red Lodge Creek Below Reservoir, monitors current outflows from the reservoir. The gage is located on the right bank of Red Lodge Creek 1.5 miles downstream from Cooney Dam.

WEATHER MONITORING

The dam operator monitors weather conditions through local weather forecasts and the National Weather Service (NWS).

If severe flooding is anticipated, the NWS Billings Office **(800-240-4596 or 406-652-2314)** should be requested to make "forecast points" of the two U.S. Geological Survey (USGS) stream gages above Cooney Reservoir (06211000 and 06212500). If this request is adopted, NWS will provide peak flow, storm duration, runoff duration (above base flow), and total volume flood forecasts for these two stream gauges as conditions warrant.

INTERACTION WITH OTHER DAMS

The only dams located upstream or downstream from Cooney Dam (at least within the boundaries of Montana) are irrigation diversion dams. The safety of these dams is not affected by the operation of Cooney Dam during either normal or emergency operations. Therefore, interaction with other dams is not a concern to the operation of Cooney Dam.

EMERGENCY

If it appears that the Cooney Dam is about to breach, or during emergency operations, the dam operator will initiate the **Cooney Dam Emergency Action Plan**.

INSPECTION AND MONITORING

Annual inspections are conducted by the SWPB. Appendix C includes an example of a SWPB inspection report form. In addition to annual inspections, SWPB personnel will inspect the dam and reservoir during and after heavy runoff and severe rainstorms and windstorms, during high storage periods, and after an earthquake. The water surface through the embankment is monitored by using monitoring wells.

STRUCTURAL FEATURES INSPECTION

Structural features include the outlet works, bridge, ogee crest, channel lining, flip bucket, and baffled apron drop structure. The SWPB inspects these structures annually as part of its inspection program. Items to be checked or noted include, but are not limited to:

1. Outlet Works
 - a. Any differential settlement or movement resulting in cracking of the conduit
 - b. Erosion of the steel liner, deflector, seals, control rod, or concrete by cavitation immediately downstream of the butterfly gate
 - c. Major seepage of water into the conduit
 - d. Major deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
 - e. Operation of both gates through a full cycle
 - f. Jet pump, for obstructions and operation
(see drawing - Appendix F)
 - g. Air vent for free, unobstructed operation
 - h. Corrosion of any metal
 - i. Proper lubrication of the gate pedestals
2. Gatehouse—Any damage or vandalism

3. Bridge
 - a. Deterioration of bridge surface or grout in shear keys
 - b. Corrosion of steel
 - c. Major structural cracking of wingwalls or abutment walls
 - d. Deterioration of elastomeric bearing pads
4. Ogee Crest and Channel Lining
 - a. Drainage system for evidence of plugging
 - b. Air inlet screen under south end of bridge
 - c. Cracking or movement of concrete slab, or deterioration of concrete
 - d. Blockage or silt deposits in the approach channel near the crest
5. Flip Bucket Spillway
 - a. Drainage weep holes for evidence of plugging or piping
 - b. For cavitation damage along upper slab or spillway
 - c. Erosion under lip of flip bucket
 - d. Cracking or movement of slab or walls
 - e. Separation or movement of joints
 - f. Erosion of the backfill behind the walls
6. Baffled Apron Drop Structure
 - a. Plugging of drainage system
 - b. Accumulation of trash in baffles
 - c. Freeze/thaw deterioration at waterline in lower section of structure
 - d. Differential movement of slabs at contraction joints.
7. Embankment
 - a. Erosion gullies in the dam
 - b. Damage from burrowing animals or vegetation
 - c. Displacement or loss of rip-rap protection
 - d. Displacement of fill, sink holes, slumps etc.
 - e. Any seepage

FUSE PLUG INSPECTION

The downstream portion of the fuse plug is constructed of easily erodible sand and is designed to fail rapidly should it be overtopped. For this reason, the downstream face should be kept clear of vegetation or any armoring that would inhibit erosion of the sand.

The fuse plug is designed not to fail during an event less than the 100-year flood, but to fail immediately after the peak of the 100-year flood. The elevation of the fuse plug is critical to its proper operation. Therefore, the low point of the fuse plug road surface should be maintained 3.69 feet below the top of the bridge deck (center, north abutment). This elevation difference should be checked annually and adjusted if off more than 0.1 foot.

RIPRAP INSPECTION

The riprap on the upstream face of the dam, along the fuse plug, and within the plunge pool area should be at least 30 inches thick. The upper portion of the riprap on the face of the dam contains shale and dirt when constructed and was overbuilt to allow for erosion and settlement of fines. Immediately after the occurrence of high water, the riprap will be inspected and additional riprap added if needed. The sandstone riprap used on the dam is not durable, and the addition of riprap should be planned as a frequent maintenance item.

MONITORING OF EMBANKMENT MEASUREMENT POINTS

Seven monument points are located on the downstream slope of the dam embankment. The vertical and horizontal position of these points should be surveyed in four-year intervals. The "as-built" location of the points and the reference monuments is detailed in Table 8 (Appendix B) and shown in Figure 3. However, the monument at station 15+01.25 has been lost. The

vertical movement during the four-year period in excess of 0.5 foot and horizontal movement in excess of 0.2 foot are cause for additional investigation.

The embankment should be inspected for cracking, slumping, or bulging that changes from the "as-built" condition. It should be noted that a slight overbuild was left during placing of topsoil on the downstream slope of the dam. The overbuild should not be taken as slumping of the embankment. The monument points should be used as the primary indicators of instability.

DRIANS

The original drawings for the dam show three 12-inch diameter drains: one in the right abutment area above the outlet, one along the right half of the toe of the dam, and the other one along the left half of the toe of the dam.

Right Abutment Drains: The 12-inch right abutment drain originally exited above the outlet, but as part of the 1982 construction the drainpipe was extended so that it now discharges into the outlet stilling basin. The flow from the drain varies with the elevation of the reservoir pool.

During the 1982 construction, additional drains were installed in the right abutment consisting of five horizontal drains and a blanket drain. Each horizontal drain extends approximately 150 feet into the abutment. The horizontal drains and the blanket drain terminate in a manhole located in the right abutment and then discharge from the manhole through a 8-inch pipe into the outlet stilling basin.

Toe Drains: The two 12-inch toe drains originally exited in the old stream channel, but as part of the 1982 construction the two drains were joined together and the outlet extended. The toe

drains now exit in an oxbow closer to Red Lodge Creek (the outlet channel). The outlet end of the drain is normally submerged. Flowing water can be seen at the exit of the pipe, but no flow estimate has been made.

Interceptor Drain: An interceptor drain at the toe of the dam was part of the 1982 construction. The interceptor drain is designed to collect any additional seepage from the right abutment that the right abutment drains do not collect. The interceptor drain exits into the outlet channel below the weir and is normally submerged. When the outlet gate is closed, the interceptor outlet is visible, but no flow has been observed exiting this drain.

SEEPAGE

Right Abutment: Seepage has been observed flowing over the outlet wing walls, but is not measurable. There are willows growing on the abutment above the outlet. This condition has been observed for many years. The water users have been working on removing the willows from this area.

Toe Area of Dam: On the north side of the county road there are a number of beaver dams in the old stream channel, which pond the water. The seepage flow from the spillway discharges into this area. It is not known if the water stored behind the beaver dams is from seepage at the toe of the dam or from the spillway.

There is a low area lying near the entrance gate to the toe area where the surface runoff water collects, which makes the area wet and boggy. This area is just above (vertically) the old stream channel and could be partly caused by seepage. A shallow drain swale has been recommended to be constructed in the area to carry the water away.

Spillway Channel Area: Seepage has been observed exiting from the left side of the spillway channel in the abutment just below the principal drop structure, above the left wingwall of the baffled apron drop, and from both sides of the channel below the baffled apron drop structure.

MONITORING WELLS

Eight monitoring wells were drilled at Cooney Dam in 1983. One standpipe was completed per drill hole except for DH-303 which has two standpipes. The nine standpipes include five slotted pipe observation wells, two Casagrande piezometers, and two slope inclinometer tubes. The location of the wells is shown in Figure 3 and also described in Appendix E. Soil profiles of the drill holes and details as to how the wells were constructed are shown in Appendix E.

The two slope inclinometer drill holes are located in the dam embankment and the right abutment above the outlet. Slope tube #305-S (located on the dam crest) was partially plugged in 1996 approximately 48 feet down in the hole. The upper portion of the hole is still providing useful data. Attempts have been made in the past to remove the obstruction, but the attempts have failed.

SEEPAGE MONITORING

The monitoring wells, drains and seepage areas are observed and monitored by the Billings Regional Office during regular visits; and may be measured by the SWPB during annual inspections. The instruments are generally measured twice per month from May 1 to August 31, and once per month in March, April, September, and October. Measurements may be taken during the winter months (November, December, January, February) depending on weather conditions.

The slope tubes are normally measured with a slope inclinometer annually during the summer months, but there is no specific month that the measurements are made. A variation of approximately one-half inch from the previous year's slope tube readings should be investigated.

The drains exiting into the manhole are generally measured three to four times per year, during the period from April through September of each year. Increasing or decreasing seepage rates for a given pool elevation may be cause for concern or maintenance. If the rate is increasing, piping or stability problems may be developing in the embankment or the abutments. A decreasing rate would indicate a need for cleaning and maintenance of the drain system.

The following drain system items should be observed and measured:

1. Toe Drain.
Observe flow. Look for the 12-inch blue PVP pipe outlet in slough below ditch crossing near Red Lodge Creek.
2. Interceptor Drain.
Observe flow. Look for the 8-inch blue PVC pipe outlet 100 feet below weir in Red Lodge Creek.
3. Right Abutment Drain.
Observe and measure flow. Look for 12-inch (white pipe) discharging into the stilling basin of outlet tunnel.
4. Manhole Outlet Pipe.
Observe and measure flow. Look for 8-inch blue PVC pipe discharging into the stilling basin of outlet tunnel.
5. Manhole Drains.
Observe and measure flow. The drain numbers are labeled inside the manhole, and their relative locations are shown in Figure 4.

[Faint, illegible text covering the majority of the page, likely bleed-through from the reverse side.]

MAINTENANCE

The association is responsible for routine maintenance of the project. In addition, the SWPB may identify items that need maintenance or repair during the annual inspection.

ROUTINE MAINTENANCE

To protect the dam and keep it in good working order, the dam operator during regular visits to the dam will watch for and identify any potential maintenance requirements. As soon as a need is identified, the dam operator needs to schedule and perform the routine maintenance.

Items that may occasionally need attention include, but are not limited to:

1. *Lubrication and cleaning of the gate-operating mechanisms.*
2. *Debris or silt restricting the spillway inlet channel, outlet channel, or weir.* Accumulated debris that could affect the operation of these appurtenances will be removed at once, with all debris removed at least annually before the runoff season.
3. *Erosion gullies on embankment.* Development of erosion gullies will be checked immediately. Gullies will be filled, compacted, and seeded. Particular attention will be paid to the abutment contact areas and the downstream face where four-wheel drive tracks may be a problem. The cut along the contact of the embankment and the natural ground surface should be maintained to discourage driving up and down the downstream face of the embankment.
4. *Rodent damage.* The rodents will be removed or destroyed, and any burrow holes should be filled immediately.
5. *Upstream slope riprap.* The upstream face riprap normally will be observed annually, but may occasionally need repairs because of high water or wave action.

6. *Vegetative cover on downstream slopes.* Good vegetative cover will be maintained, but large brush and any trees will be removed.
7. *Noxious weeds.* Noxious weeds on and around the dam embankment and around the reservoir shall be sprayed at least on an annual basis.
8. *Cleaning spillway and outlet wall tops.* Spillway and outlet wall tops should be clear of any dirt, rocks, grass, brush, and any overhanging vegetation or trees.
9. *Repair of the spillway joints and sealing of cracks in the spillway.*

ANNUAL MAINTENANCE

The SWPB conducts annual inspections of the Cooney Dam and reservoir. During these inspections, any items requiring annual maintenance will be identified and recorded. Items that may need annual maintenance include the outlet works, gates, jet pump, baffled apron drop, drainage system, monitoring wells or tubes, weir, riprap, roads and gatehouse. Other routine items needing immediate attention, such as the need to remove trees or brush, will also be noted.

After the inspection, the SWPB sends the association a Dam Safety Inspection Report and a Maintenance Report. The reports identify items that need maintenance and provide a schedule of when the maintenance tasks need to be completed. The association is responsible for performing the maintenance items within the times specified.

The dam operator or association members may perform the maintenance tasks. However, major repairs will likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

RECORD KEEPING

The SWPB will maintain records—including photographs—of all inspections and maintenance requirements. These SWPB's records also include flow measurements, storage volumes and instrumentation readings. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in Helena.

The dam operator will keep records of the reservoir elevation, seepage observation or measurements, and any unusual conditions. These records may be reviewed at the dam operator's house.

REFERENCES

- U.S. Army Corps of Engineers, Seattle District. May 1978. Phase I Inspection Report; National Dam Safety Program; Red Lodge Creek/Willow Creek Basins, Cooney Dam, Boyd Montana, (MT 1). Prepared for the State of Montana (DNRC) under the U.S. Army Corps of Engineers' National Dam Safety Program.
- HKM Associates. April 1978. Rehabilitation of Cooney Dam Spillways. Prepared for the DNRC, State Water Projects Bureau, Helena, Montana by HKM Associates, Billings, Montana.
- HKM Associates. April 1981. Design Summary Cooney Dam Project, Carbon County, Montana. Prepared for the DNRC, State Water Projects Bureau, Helena, Montana by HKM Associates, Billings, Montana.
- HKM Associates. April 1981. Appendix B Laboratory Test Results And Logs Of Exploration Holes, Cooney Dam Project, Carbon County, Montana. Prepared for the DNRC, State Water Projects Bureau, Helena, Montana by HKM Associates, Billings, Montana.

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APPENDICES

APPENDIX A

GENERAL FILLING SCHEDULE AND RELEASE

PROCEDURES

GENERAL FILING AND RELEASE PROCEDURES

This appendix provides guidance for making reservoir management decisions based on water supply forecasts and reservoir storage that will best serve agricultural needs while minimizing safety risks to downstream residents and property.

OPERATING CRITERIA

Normal operation and maintenance are accomplished by the Rock Creek Water Users Association (association). The dam operator performs day-to-day project regulation. Project visitations are made at least daily during the reservoir filling period and weekly during the winter months. The general operating schedule is shown as follows:

1. Begin Filling Reservoir

Usually in April or May; however, depends upon snowpack, runoff pattern, and annual storage carryover. In low runoff years, storage may begin before April to minimize impacts from senior water rights. In high runoff years, the reservoir is operated to minimize flood flows and will likely fill after June 15.

2. Reach Maximum Storage -- June 15 (variable)

3. Begin Irrigation Releases

Late April at the earliest. During some years irrigation releases have not been required.

4. End Irrigation Releases -- September 15 (variable)

The project normally has been operated during the winter months to maintain the pool near elevation 4,237.3 feet, impounding an average of about 17,700 acre-feet (af) since 1982. Data from the Natural Resource Conservation Service (NRCS), previously the U.S. Soil Conservation Service, snow course measurements have been used by the association in planning for the pool filling operation. Maintaining a constant storage level

between 15,000 af and 22,000 af will allow the reservoir to fill to its maximum active capacity (28,140 af) in 9 of 10 years during the period of April 1 to June 15. Carryover storage of 15,000 af will allow filling of the reservoir in 8 of 10 years. These conclusions are based on the assumption that runoff patterns similar to historical runoff patterns (1937 to present) will occur in the months of April, May and June.

HYDROLOGIC DATA

The primary sources of water are melting winter snowpack and spring and summer rains. Major factors influencing runoff are snow water equivalent, temperature, and precipitation.

The U.S. Geological Survey (USGS) records inflow to the reservoir at the following gages: Red Lodge Creek near Boyd, Montana (06211000), and Willow Creek near Boyd, Montana (06211500). Records are available from May 1937 to the present. However, winter records are not available for most years. Monthly reservoir pool elevations are recorded by the USGS based on dam operator readings. Records are available from May 1937 to the present. Records for the period 1954 - 1960 are incomplete.

The NRCS publishes April-July and May-July streamflow forecasts for inflows into Cooney Reservoir near Boyd in the publication *Montana Water Supply Outlook*. The forecasts are published monthly from February 1 to May 1. Immediate forecasts can be obtained by calling the NRCS in Bozeman (406-587-6991). These forecasts are based on snow survey information and precipitation and temperature data in the Red Lodge Creek and Willow Creek drainage basins upstream of Cooney Dam.

RESERVOIR MANAGEMENT

The primary goal of Cooney Reservoir management is providing an adequate supply of water for irrigation without exceeding safe levels of flow. A secondary goal is providing adequate flows for fisheries and recreation downstream of the dam. No minimum flow levels have been established at this time.

In low runoff years, storage will be a function of releases made to senior water right holders. Operation in dry years will depend a great deal upon the water commissioner assigned to regulate diversions. In dry years, the reservoir may not fill completely, and continuous adjustments are necessary.

Simplified reservoir operating curves were developed to assist in determining the proper outflow at the dam given a high runoff year. One set of curves, Figure No. A1, is for April 1-June 15 operation, and the other set, Figure No. A2, is for May 1- June 15 operation. These curves will be discussed in the next two sections, "Reservoir Operating Curves" and "Instructions For Using Reservoir Operating Curves."

Refer to Figure No. A3 for a graphical representation of how the reservoir is manipulated by use of the curves given a normal-to-wet runoff year. Historically, the reservoir pool has been held constant from the end of the irrigation season in the fall until April 1 (assuming ice is not a problem). During this period outflow equals inflow, as represented on the portion of the curve referenced as (1) in Figure No. A3. Normally, an increase in storage occurs between April and June 15 up to the full pool level. A reservoir outflow for this period (2) is selected. On May 1 the NRCS issues a May-July forecast, and the reservoir outflow is adjusted if necessary (3). The quantity of water being stored in the reservoir is represented by the cross-hatched area of Figure A3, and the amount released from storage is shown as the dotted area. Necessary irrigation releases begin in mid-June, and reservoir

releases are made to satisfy demand (4). It should be noted that, during (2) and (3), the dam operator may have to make adjustments in outflow if it appears the target storage level is not being reached.

RESERVOIR OPERATING CURVES

Reservoir outflow for April 1 or May 1 to June 15 can be obtained from the operating curves (Figure Nos. A1 and A2) by entering the NRCS runoff forecast amount and the beginning-of-month reservoir storage. The curves were developed by studying the relationship between inflow, outflow, and change in storage. Evaporation and seepage are insignificant compared to inflow, so they were not used in developing the curves. It is assumed that the reservoir releases through the irrigation season will be controlled by the dam operator on demand. Releases from the end of the irrigation season until April 1 will be set so outflow equals inflow. The target storage is approximately 22,000 af if demands do not lower storage beyond this point.

INSTRUCTIONS FOR USING RESERVOIR OPERATING CURVES

Reservoir Operating Curve For April: The following instructions should be followed for the April 1 to June 15 set of curves.

1. Turn to the Reservoir Operating Curves for April 1 - June 15 (Figure No. A1).
2. Using the April - July runoff forecasts from the NRCS and the April 1 reservoir storage, use the curves to determine the required reservoir outflow.
3. If the reservoir pool level drops two days in a row, set outflow equal to inflow until the reservoir pool starts rising again. Once the pool levels starts rising, return to the outflow obtained from the curves.

Reservoir Operating Curve For May and First Two Weeks Of June: The following instructions should be followed beginning May 1.

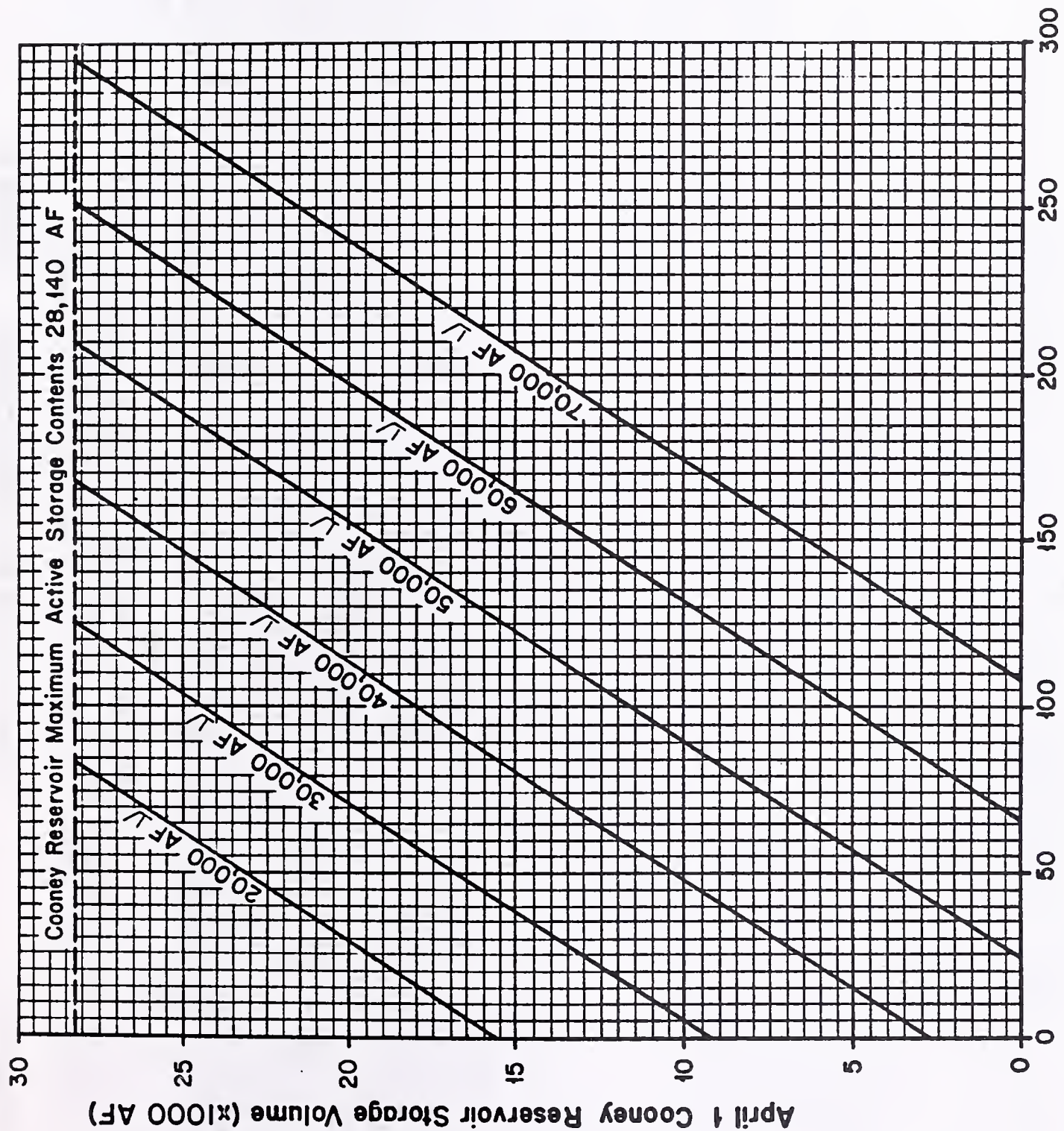
1. Turn to the Reservoir Operating Curves for May 1 - June 15 (Figure No. A2).
2. Using the May - July runoff forecasts from the NRCS and the May 1 reservoir storage, use the curves to determine the required reservoir outflow.
3. If the reservoir pool level drops two days in a row and reservoir storage is below 28,140 af, set outflow equal to inflow until the reservoir pool starts rising again. Once the pool levels starts rising, return to the outflow obtained from the curves.
4. Due to the inability to predict rainfall in developing the runoff forecasts, it may be necessary to adjust outflow near the end of May or beginning of June to reach a storage level of 28,140 af.

RESERVOIR OPERATION EXAMPLE

The following is a reservoir operation example using the operating curves and beginning on April 1.

April 1 Forecast: Assume that April 1 reservoir storage equals 15,000 af and the NRCS runoff forecast for April-July equals 40,000 af. The Reservoir Operating Curve for April 1-June 15 (Figure No. A1) indicates that a reservoir outflow of 81 cubic feet per second (cfs) is required from April 1 to June 15 to obtain the desired June 15 storage level of 28,140 af.

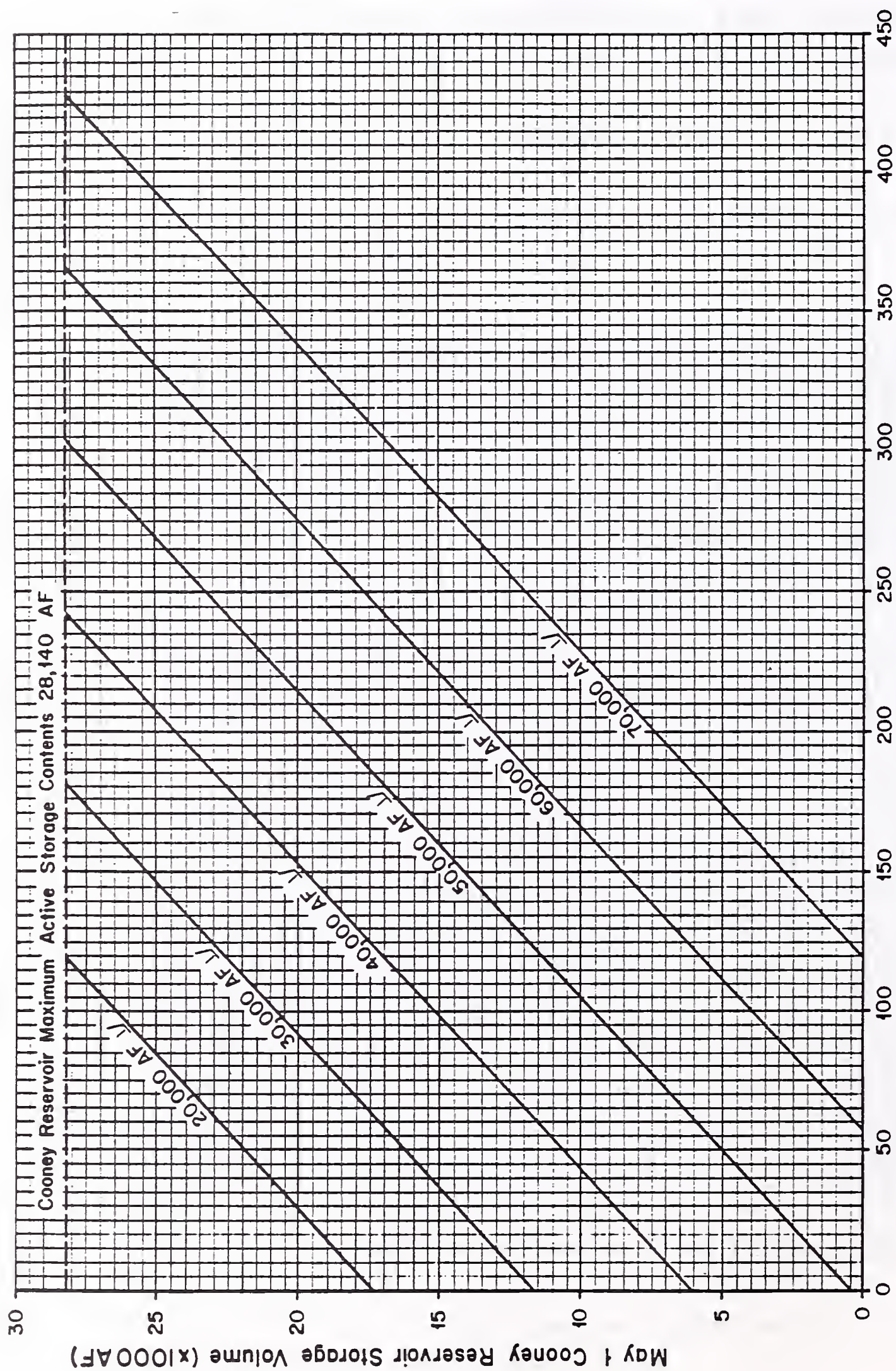
May 1 Forecast: Assume that a storage level of 17,000 af is achieved on May 1 and the NRCS May-July forecast equals 30,000 af. The Reservoir Operating Curve for May 1-June 15 (Figure No. A2) show that a reservoir outflow of 59 cfs is required to bring the reservoir storage up to the desired level of 28,140 af by June 15. Due to the inability to predict rainfall in developing the runoff forecast, an adjustment in outflow may be required near the end of the period to achieve the correct storage level.



SCS APRIL-JULY STREAMFLOW FORECAST FOR INFLOW COONEY RESERVOIR NEAR BOYD.
THE APRIL 1 - JUNE 15 RUNOFF IS 64 PERCENT OF THE APRIL-JULY FORECAST AMOUNT.

FIGURE A1

April 1 - June 15 OPERATIONAL CURVES

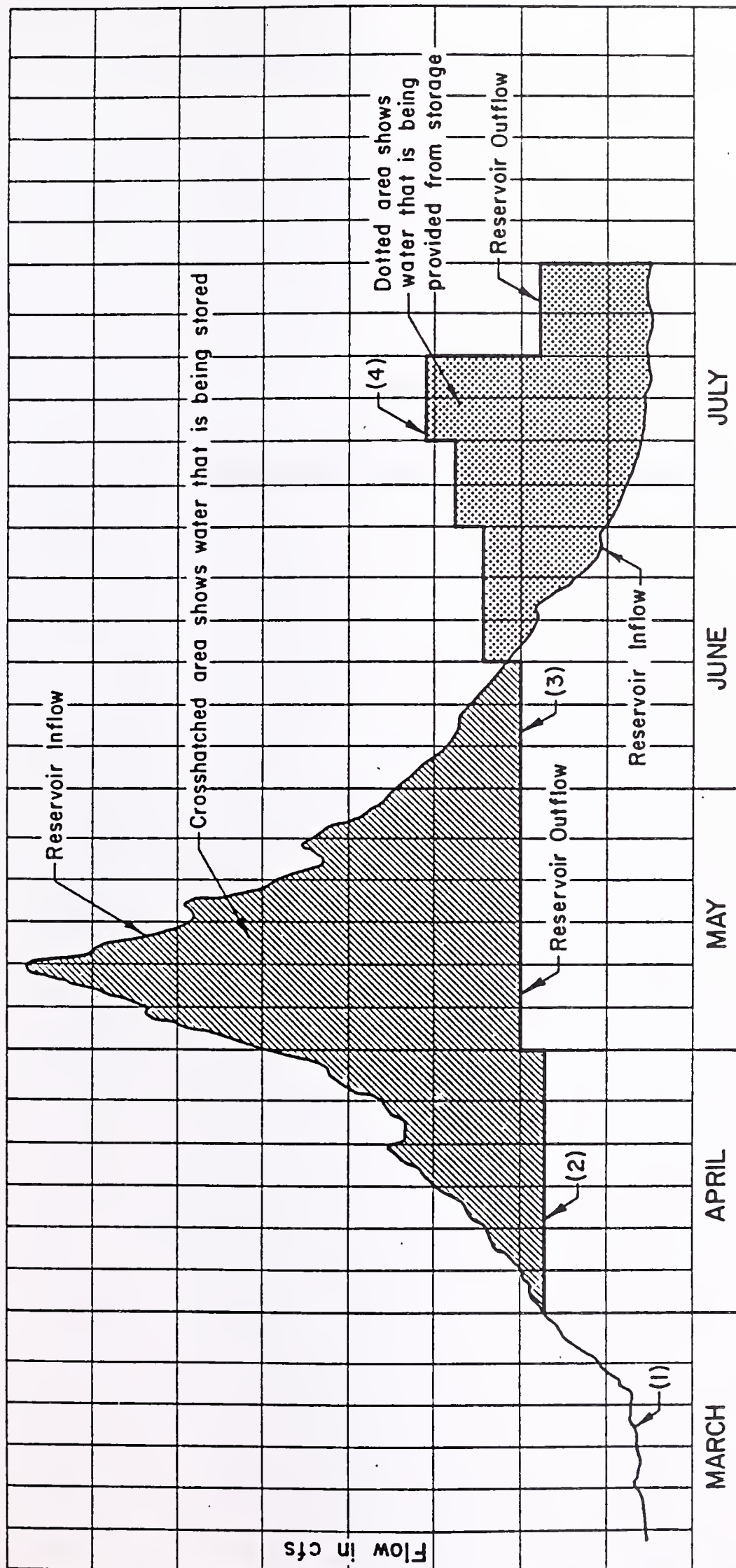


Outlet Works Release for May 1 - June 15 (cfs)

✓ SCS MAY-JULY STREAMFLOW FORECAST FOR INFLOW COONEY RESERVOIR NEAR BOYD.
THE MAY 1 - JUNE 15 RUNOFF IS 56 PERCENT OF THE MAY-JULY FORECAST AMOUNT.

FIGURE A2

May 1 - June 15 OPERATIONAL CURVES



TYPICAL INFLOW AND OUTFLOW WHEN MANAGEMENT IS BASED ON RESERVOIR CURVES

FIGURE A3

HKM ASSOCIATES
JANUARY 1983

APPENDIX B
RATING CURVES AND TABLES

**TABLE 1. SLOPE-ELEVATION-STORAGE TABLE
COONEY DAM**

Slope pins located at Marshall Cove boatramp.

Pins installed 9/24/2000 and elevations established with a level 9/25/2000.

The 0+00 pin is at the top left (southwest) corner of the boat ramp.

The alignment follows the left edge of the slab, which is the datum for the slope distances. Pins with caps were placed below the slab grade at 50 ft intervals, with top of cap elevations listed.

Storage volumes from 4/14/1983 useable storage table.

DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE
0+00 CAP	4251.19	28,306		36	4246.63	24,411
1	4251.13	28,256		37	4246.54	24,338
SPILLWAY	4251.00	28,140		38	4246.46	24,273
2	4250.96	28,105		39	4246.37	24,200
3	4250.80	27,964		40	4246.29	24,135
4	4250.63	27,814		41	4246.21	24,070
5	4250.46	27,665		42	4246.13	24,006
6	4250.29	27,515		43	4246.05	23,941
7	4250.12	27,366		44	4245.97	23,877
8	4249.96	27,225		45	4245.89	23,813
9	4249.79	27,097		46	4245.80	23,742
10	4249.62	26,929		47	4245.72	23,679
11	4249.45	26,782		48	4245.64	23,616
12	4249.28	26,634		49	4245.56	23,552
13	4249.10	26,477		50	4245.48	23,489
14	4248.93	26,331		0+50 CAP	4245.37	23,402
15	4248.76	26,187		51	4245.40	23,426
16	4248.59	26,042		52	4245.31	23,355
17	4248.42	25,897		53	4245.23	23,291
18	4248.24	25,744		54	4245.14	23,220
19	4248.07	25,600		55	4245.06	23,158
20	4247.90	25,457		56	4244.97	23,087
21	4247.82	25,390		57	4244.89	23,025
22	4247.75	25,332		58	4244.80	22,956
23	4247.67	25,266		59	4244.72	22,894
24	4247.59	25,200		60	4244.63	22,825
25	4247.52	25,142		61	4244.55	22,764
26	4247.44	25,076		62	4244.46	22,694
27	4247.36	25,009		63	4244.38	22,632
28	4247.28	24,943		64	4244.30	22,571
29	4247.21	24,886		65	4244.22	22,509
30	4247.13	24,820		66	4244.13	22,440
31	4247.05	24,754		67	4244.05	22,379
32	4246.96	24,680		68	4243.97	22,318
33	4246.88	24,615		69	4243.88	22,250
34	4246.79	24,541		70	4243.80	22,190
35	4246.71	24,475		71	4243.73	22,138
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

**TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)
COONEY DAM**

DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE
72	4243.65	22,078		116	4240.82	20,026
73	4243.58	22,026		117	4240.75	19,978
74	4243.51	21,973		118	4240.68	19,929
75	4243.44	21,921		119	4240.61	19,881
76	4243.36	21,861		120	4240.54	19,833
77	4243.29	21,808		121	4240.46	19,777
78	4243.22	21,755		122	4240.39	19,729
79	4243.14	21,695		123	4240.31	19,674
80	4243.07	21,643		124	4240.24	19,626
81	4243.00	21,591		125	4240.16	19,571
82	4242.93	21,539		126	4240.08	19,515
83	4242.85	21,480		127	4240.01	19,467
84	4242.78	21,429		128	4239.93	19,414
85	4242.71	21,378		129	4239.86	19,368
86	4242.64	21,327		130	4239.78	19,315
87	4242.57	21,276		131	4239.71	19,269
88	4242.49	21,218		132	4239.65	19,229
89	4242.42	21,167		133	4239.58	19,183
90	4242.35	21,115		134	4239.51	19,137
91	4242.30	21,079		135	4239.45	19,097
92	4242.24	21,035		136	4239.38	19,051
93	4242.19	20,998		137	4239.31	19,004
94	4242.14	20,962		138	4239.24	18,958
95	4242.09	20,925		139	4239.18	18,919
96	4242.03	20,883		140	4239.11	18,872
97	4241.98	20,847		141	4239.04	18,826
98	4241.93	20,811		142	4238.97	18,780
99	4241.87	20,768		143	4238.91	18,740
100	4241.82	20,732		144	4238.84	18,694
1+00 CAP	4241.37	20,413		145	4238.77	18,648
101	4241.76	20,690		146	4238.70	18,602
102	4241.70	20,647		147	4238.63	18,556
103	4241.65	20,611		148	4238.57	18,516
104	4241.59	20,569		149	4238.50	18,470
105	4241.53	20,526		150	4238.43	18,424
106	4241.47	20,484		1+50 CAP	4238.38	18,391
107	4241.41	20,441		151	4238.34	18,364
108	4241.36	20,406		152	4238.26	18,312
109	4241.30	20,363		153	4238.17	18,253
110	4241.24	20,321		154	4238.08	18,193
111	4241.17	20,271		155	4238.00	18,141
112	4241.10	20,221		156	4237.91	18,082
113	4241.03	20,171		157	4237.82	18,023
114	4240.96	20,123		158	4237.73	17,965
115	4240.89	20,075		159	4237.65	17,913
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)
COONEY DAM

DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE
160	4237.56	17,854		204	4233.15	15,082
161	4237.46	17,790		205	4233.03	14,986
162	4237.36	17,725		206	4232.90	14,931
163	4237.26	17,660		207	4232.77	14,853
164	4237.16	17,595		208	4232.64	14,776
165	4237.06	17,530		209	4232.52	14,704
166	4236.95	17,458		210	4232.39	14,627
167	4236.85	17,394		211	4232.27	14,556
168	4236.75	17,330		212	4232.15	14,484
169	4236.65	17,266		213	4232.03	14,413
170	4236.55	17,202		214	4231.91	14,343
171	4236.45	17,138		215	4231.79	14,274
172	4236.35	17,074		216	4231.73	14,239
173	4236.26	17,016		217	4231.67	14,204
174	4236.16	16,953		218	4231.60	14,163
175	4236.06	16,889		219	4231.54	14,128
176	4235.96	16,825		220	4231.48	14,094
177	4235.86	16,762		221	4231.39	14,042
178	4235.77	16,705		222	4231.30	13,989
179	4235.67	16,642		223	4231.21	13,937
180	4235.57	16,579		224	4231.12	13,885
181	4235.48	16,523		225	4231.04	13,839
182	4235.38	16,460		226	4230.95	13,787
183	4235.29	16,403		227	4230.86	13,735
184	4235.20	16,346		228	4230.77	13,684
185	4235.11	16,289		229	4230.68	13,633
186	4235.01	16,227		230	4230.59	13,582
187	4234.92	16,170		231	4230.34	13,441
188	4234.83	16,114		232	4230.09	13,301
189	4234.73	16,052		233	4229.84	13,162
190	4234.64	15,996		234	4229.59	13,022
191	4234.54	15,934		235	4229.52	12,984
192	4234.44	15,873		236	4229.45	12,946
193	4234.35	15,817		237	4229.39	12,914
194	4234.25	15,755		238	4229.32	12,876
195	4234.15	15,693		239	4229.25	12,838
196	4234.05	15,631		240	4229.18	12,800
197	4233.95	15,570		241	4229.15	12,784
198	4233.86	15,515		242	4229.11	12,763
199	4233.76	15,454		243	4229.08	12,746
200	4233.66	15,393		244	4229.04	12,725
2+00 CAP	4233.50	15,295		245	4229.01	12,709
201	4233.53	15,313		246	4228.98	12,693
202	4233.41	15,240		247	4228.94	12,671
203	4233.28	15,161		248	4228.91	12,655
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)
COONEY DAM

[illegible]

TABLE 2. ACTIVE STORAGE IN ACRE-FEET**COONEY RESERVOIR**

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
4175	0	4	8	12	16	20	24	28	32	36
4176	40	44	48	52	56	60	64	68	72	76
4177	80	84	88	92	96	101	105	109	113	117
4178	121	125	129	133	137	141	145	149	153	157
4179	161	165	169	173	177	181	185	189	193	197
4180	201	209	217	225	233	242	250	258	266	274
4181	282	290	298	306	314	323	331	339	347	355
4182	363	371	379	387	395	404	412	420	428	436
4183	444	452	460	468	476	485	493	501	509	517
4184	525	533	541	549	557	566	574	582	590	598
4185	606	614	621	629	637	644	652	660	667	675
4186	683	690	698	706	713	721	729	736	744	752
4187	759	767	775	782	790	798	805	813	820	828
4188	836	843	851	859	866	874	882	889	897	905
4189	912	920	928	935	943	951	958	966	974	981
4190	989	1,003	1,017	1,030	1,044	1,058	1,072	1,086	1,100	1,113
4191	1,127	1,141	1,155	1,169	1,182	1,196	1,210	1,224	1,238	1,252
4192	1,265	1,279	1,293	1,307	1,321	1,335	1,348	1,362	1,376	1,390
4193	1,404	1,417	1,431	1,445	1,459	1,473	1,487	1,500	1,514	1,528
4194	1,542	1,556	1,569	1,583	1,597	1,611	1,625	1,639	1,652	1,666
4195	1,680	1,697	1,714	1,732	1,749	1,766	1,783	1,800	1,818	1,835
4196	1,852	1,869	1,886	1,904	1,921	1,938	1,955	1,972	1,990	2,007
4197	2,024	2,041	2,058	2,076	2,093	2,110	2,127	2,144	2,162	2,179
4198	2,196	2,213	2,230	2,248	2,265	2,282	2,299	2,316	2,334	2,351
4199	2,368	2,385	2,402	2,420	2,437	2,454	2,471	2,488	2,506	2,523
4200	2,540	2,563	2,585	2,608	2,630	2,653	2,675	2,698	2,720	2,743
4201	2,765	2,788	2,811	2,834	2,857	2,880	2,903	2,926	2,949	2,972
4202	2,995	3,019	3,042	3,066	3,089	3,113	3,136	3,160	3,183	3,207
4203	3,230	3,254	3,278	3,302	3,326	3,350	3,374	3,398	3,422	3,446
4204	3,470	3,495	3,519	3,544	3,568	3,593	3,617	3,642	3,666	3,691
4205	3,715	3,740	3,765	3,790	3,815	3,840	3,865	3,890	3,915	3,940
4206	3,965	3,991	4,017	4,042	4,068	4,094	4,120	4,146	4,171	4,197
4207	4,223	4,250	4,276	4,303	4,329	4,356	4,382	4,409	4,435	4,462
4208	4,488	4,516	4,543	4,571	4,598	4,626	4,653	4,681	4,708	4,736
4209	4,763	4,792	4,820	4,849	4,878	4,907	4,935	4,964	4,993	5,021
4210	5,050	5,080	5,110	5,140	5,170	5,200	5,230	5,260	5,290	5,320

TABLE 2. ACTIVE STORAGE IN ACRE-FEET (continued)**COONEY RESERVOIR**

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
4211	5,350	5,381	5,412	5,443	5,474	5,505	5,536	5,567	5,598	5,629
4212	5,660	5,692	5,724	5,756	5,788	5,820	5,852	5,884	5,916	5,948
4213	5,980	6,013	6,046	6,079	6,112	6,145	6,178	6,211	6,244	6,277
4214	6,310	6,344	6,378	6,412	6,446	6,480	6,514	6,548	6,582	6,616
4215	6,650	6,685	6,720	6,755	6,790	6,825	6,860	6,895	6,930	6,965
4216	7,000	7,036	7,072	7,108	7,144	7,180	7,216	7,252	7,288	7,324
4217	7,360	7,397	7,435	7,472	7,509	7,547	7,584	7,621	7,658	7,696
4218	7,733	7,771	7,810	7,848	7,887	7,925	7,963	8,002	8,040	8,079
4219	8,117	8,157	8,196	8,236	8,275	8,315	8,354	8,394	8,433	8,473
4220	8,512	8,553	8,594	8,634	8,675	8,716	8,757	8,798	8,838	8,879
4221	8,920	8,962	9,004	9,046	9,088	9,131	9,173	9,215	9,257	9,299
4222	9,341	9,385	9,428	9,472	9,515	9,559	9,602	9,646	9,689	9,733
4223	9,776	9,821	9,866	9,911	9,956	10,001	10,046	10,091	10,136	10,181
4224	10,226	10,273	10,319	10,366	10,412	10,459	10,505	10,552	10,598	10,645
4225	10,691	10,739	10,787	10,835	10,883	10,931	10,979	11,027	11,075	11,123
4226	11,171	11,221	11,270	11,320	11,369	11,419	11,468	11,518	11,567	11,617
4227	11,666	11,716	11,767	11,817	11,868	11,918	11,968	12,019	12,069	12,120
4228	12,170	12,223	12,275	12,328	12,381	12,434	12,486	12,539	12,592	12,644
4229	12,697	12,752	12,807	12,862	12,917	12,973	13,028	13,083	13,138	13,193
4230	13,248	13,305	13,361	13,418	13,475	13,532	13,588	13,645	13,702	13,758
4231	13,815	13,873	13,931	13,989	14,047	14,105	14,163	14,221	14,279	14,337
4232	14,395	14,455	14,514	14,574	14,633	14,693	14,752	14,812	14,871	14,931
4233	14,990	15,051	15,112	15,173	15,234	15,295	15,356	15,417	15,478	15,539
4234	15,600	15,662	15,724	15,786	15,848	15,910	15,972	16,034	16,096	16,158
4235	16,220	16,283	16,346	16,409	16,472	16,535	16,598	16,661	16,724	16,787
4236	16,850	16,914	16,978	17,042	17,106	17,170	17,234	17,298	17,362	17,426
4237	17,490	17,555	17,620	17,685	17,750	17,815	17,880	17,945	18,010	18,075
4238	18,140	18,206	18,272	18,338	18,404	18,470	18,536	18,602	18,668	18,734
4239	18,800	18,866	18,932	18,998	19,064	19,130	19,196	19,262	19,328	19,394
4240	19,460	19,529	19,598	19,667	19,736	19,805	19,874	19,943	20,012	20,081
4241	20,150	20,221	20,292	20,363	20,434	20,505	20,576	20,647	20,718	20,789
4242	20,860	20,933	21,006	21,079	21,152	21,225	21,298	21,371	21,444	21,517
4243	21,590	21,665	21,740	21,815	21,890	21,965	22,040	22,115	22,190	22,265
4244	22,340	22,417	22,494	22,571	22,648	22,725	22,802	22,879	22,956	23,033
4245	23,110	23,180	23,250	23,320	23,390	23,460	23,530	23,600	23,670	23,740

TABLE 2. ACTIVE STORAGE IN ACRE-FEET (continued)

COONEY RESERVOIR

[illegible]

NOTE: Above table based on January 1983 storage table from HKM Associates.

Guard Dike Crest	Elevation 4,251 feet	Storage 28,140 acre-feet
Emergency Spillway Crest	Elevation 4,254.15 feet	Storage 31,006 acre-feet
Dam Crest	Elevation 4,265 feet	

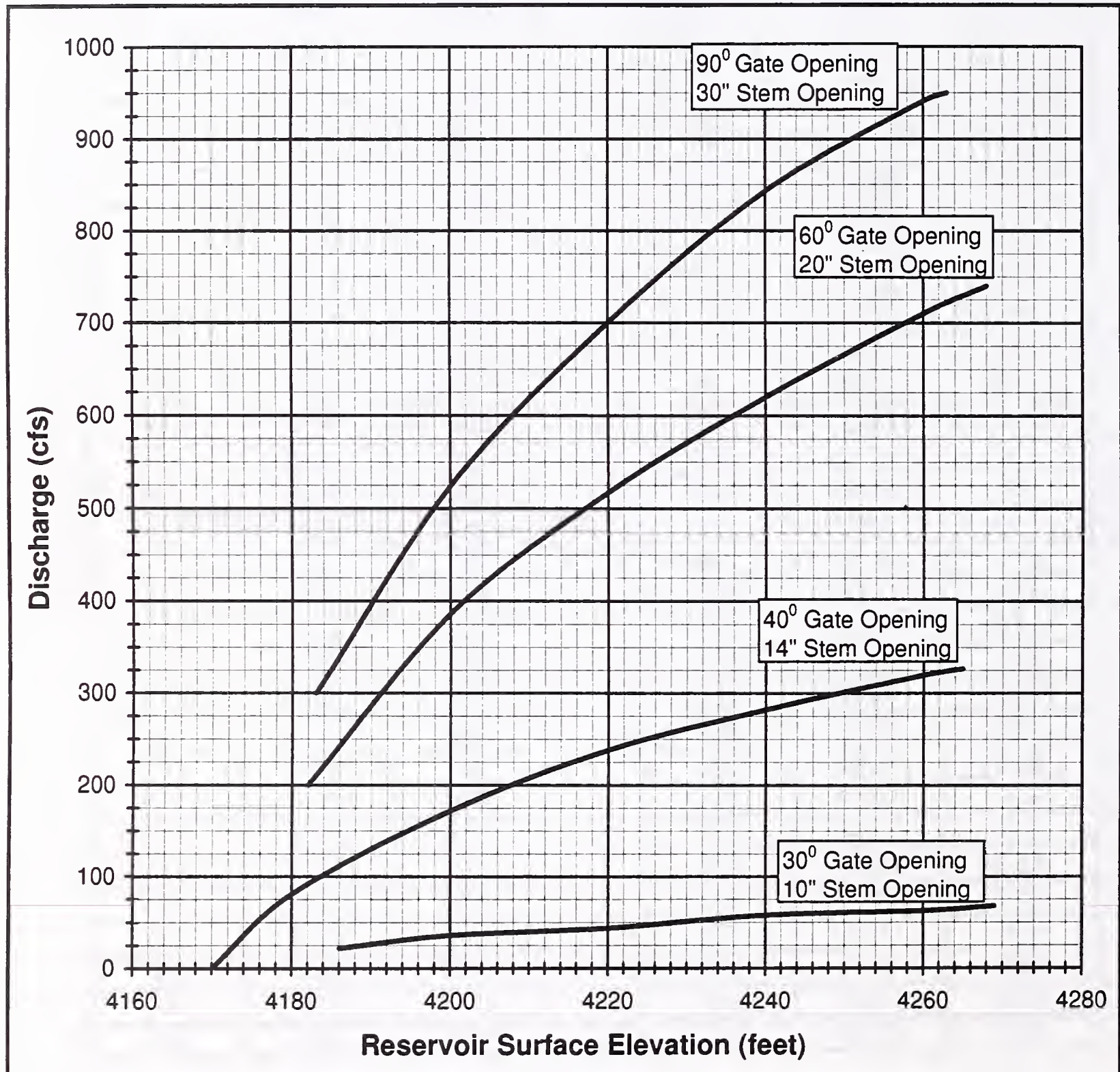
TABLE 3. SAFE DRAWDOWN RATES**COONEY DAM**

POOL ELEVATION (ft)	WATER STORED (af)	ADD TO INFLOW (cfs)		POOL ELEVATION (ft)	WATER STORED (af)	ADD TO INFLOW (cfs)
4251	28140	444		4223	9776	219
4250	27260	439		4222	9341	212
4249	26390	429		4221	8920	206
4248	25540	419		4220	8512	199
4247	24710	454		4219	8117	194
4246	23810	353		4218	7733	188
4245	23110	388		4217	7360	182
4244	22340	378		4216	7000	177
4243	21590	368		4215	6650	171
4242	20860	358		4214	6310	166
4241	20150	348		4213	5980	161
4240	19460	333		4212	5660	156
4239	18800	333		4211	5350	151
4238	18140	328		4210	5050	145
4237	17490	323		4209	4763	139
4236	16850	318		4208	4488	134
4235	16220	313		4207	4223	130
4234	15600	308		4206	3965	126
4233	14990	300		4205	3715	124
4232	14395	292		4204	3470	121
4231	13815	286		4203	3230	119
4230	13248	278		4202	2995	116
4229	12697	266		4201	3765	113
4228	12170	254		4200	2540	87
4227	11666	250		4195	1680	70
4226	11171	242		4190	989	39
4225	10691	234		4185	606	41
4224	10226	227		4180	201	20

Add value in third or sixth column to the inflow rate to determine a release rate that does not exceed the safe drawdown rate. Total release should not exceed 550 cfs.

TABLE 4. OUTLET WORKS RATING CURVE

COONEY DAM



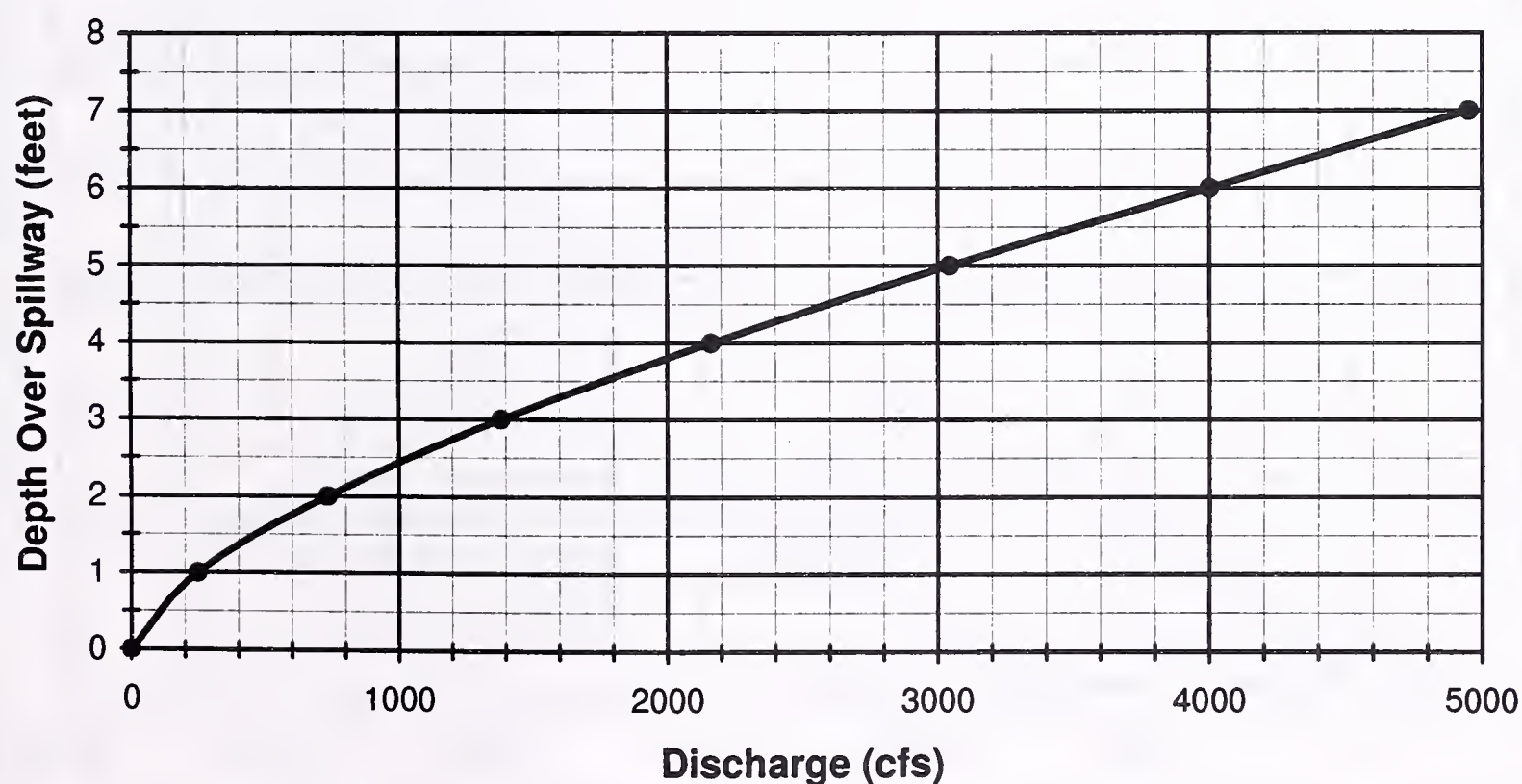
Notes:

Data from HKM Associates January 1983.

Each curve represents degree of gate opening and approximately the amount the stem extends above the top of the pedestal.

TABLE 5. PRICIPAL SPILLWAY DISCHARGE**COONEY DAM**

Depth Over Crest (feet)	Elevation (feet)	Discharge (cfs)
0	4247.3	0
1.0	4248.3	248
2.0	4249.3	733
3.0	4250.3	1382
4.0	4251.3	2162
5.0	4252.3	3044
6.0	4253.3	4002
7.0	4254.3	4952

**PRINCIPAL SPILLWAY RATING CURVE
COONEY DAM****Notes:**

Data from HKM Associates January 1983.

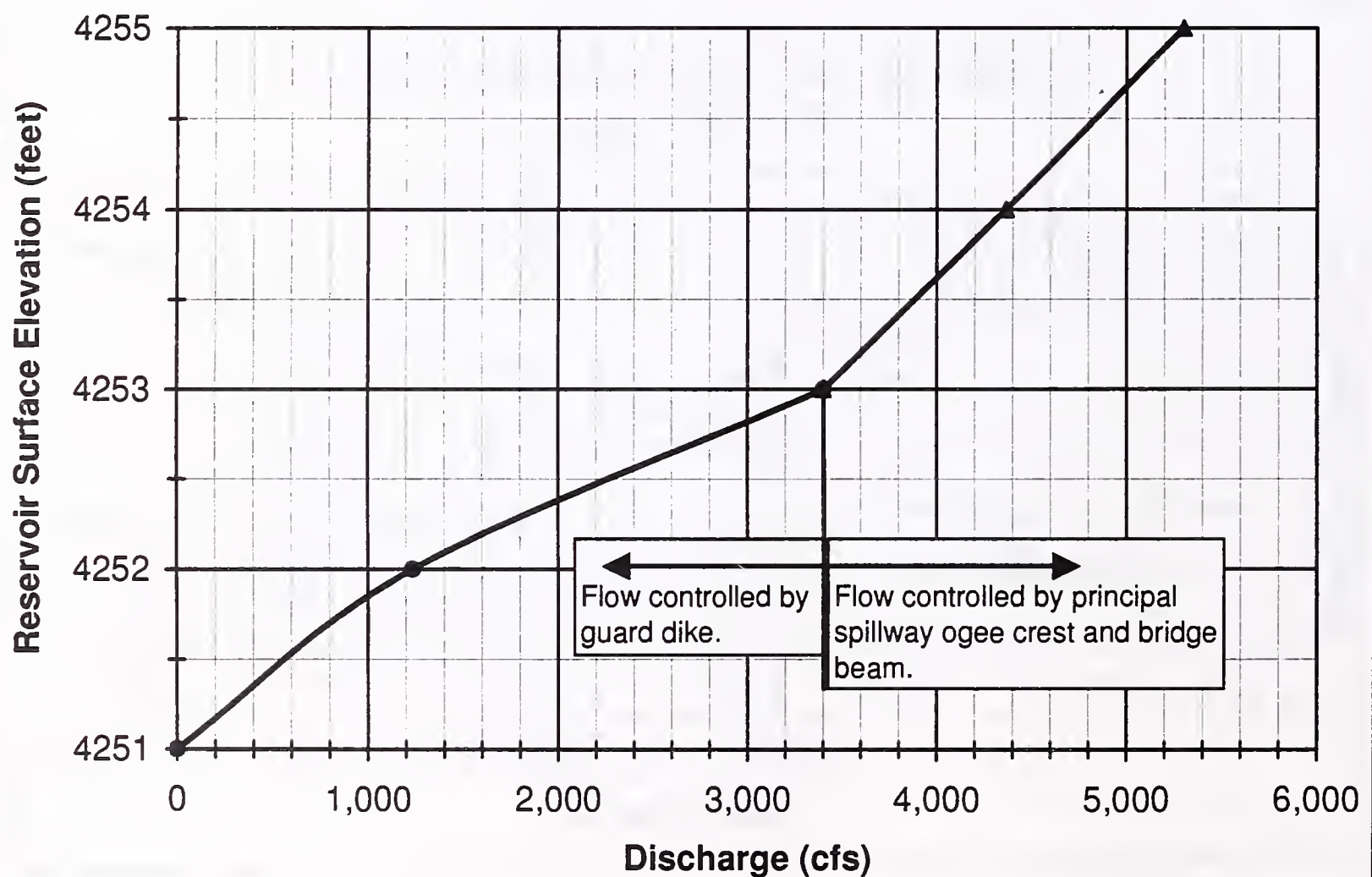
Top of north abutment wall, upstream side is 10.5 feet above top of ogee crest.

TABLE 6. PRINCIPAL SPILLWAY DISCHARGE

COONEY DAM

Reservoir Surface Elevation (feet)	Discharge (cfs)
4,251	0
4,252	1,235
4,253	3,400
4,254	4,365
4,255	5,300

**PRINCIPAL SPILLWAY RATING CURVE
COONEY DAM**



Notes:

Data from HKM Associates January 1983.

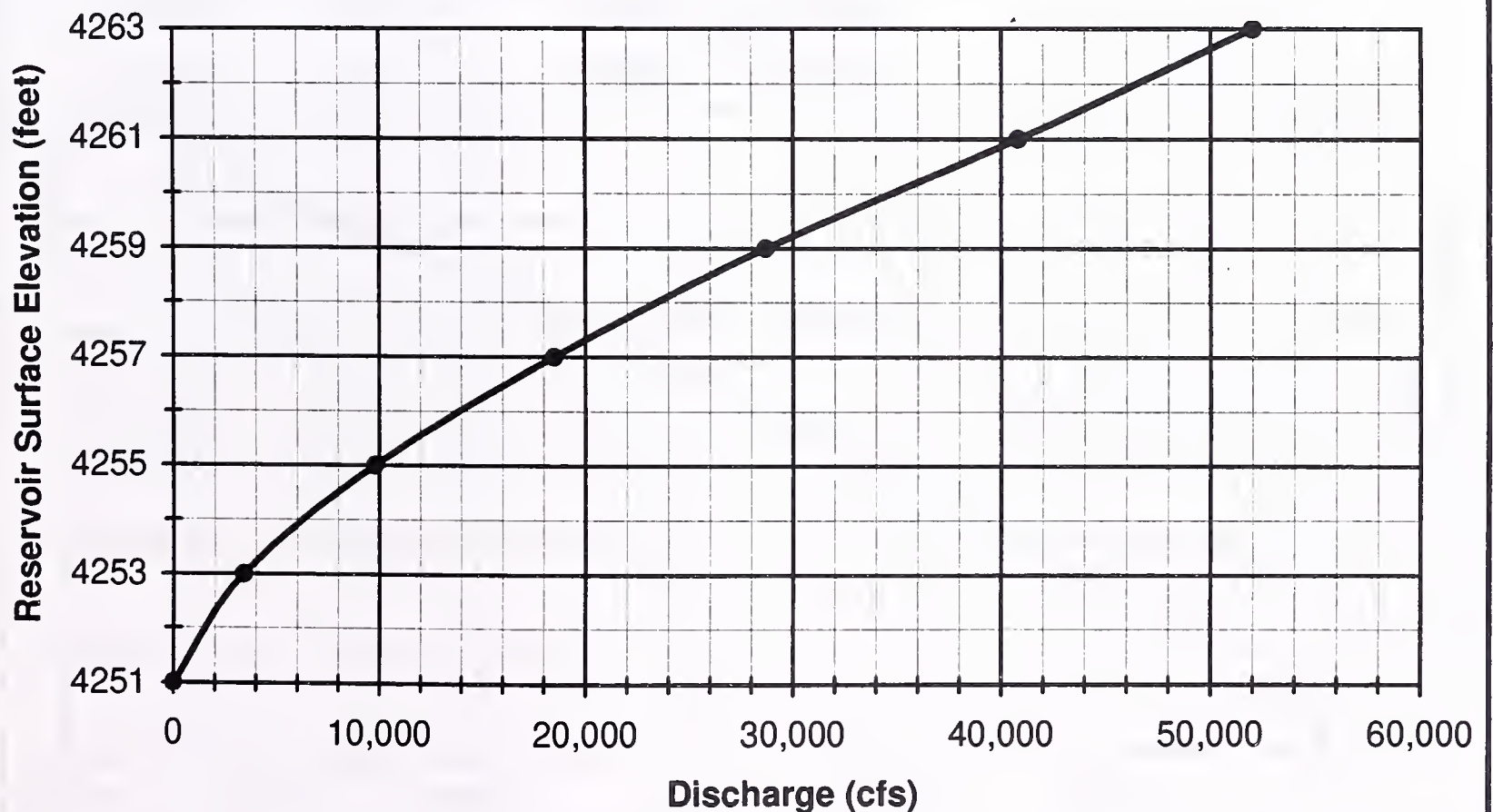
Elevation 4,251 feet --- Top of guard dike.

TABLE 7. EMERGENCY SPILLWAY DISCHARGE

COONEY DAM

Reservoir Surface Elevation (feet)	Discharge (cfs)
4,251	0
4,253	3,400
4,255	9,800
4,257	18,500
4,259	28,700
4,261	40,800
4,263	52,000

**EMERGENCY SPILLWAY RATING CURVE
COONEY DAM**



Notes:

Data from HKM Associates January 1983.

Fuse plug washed out.

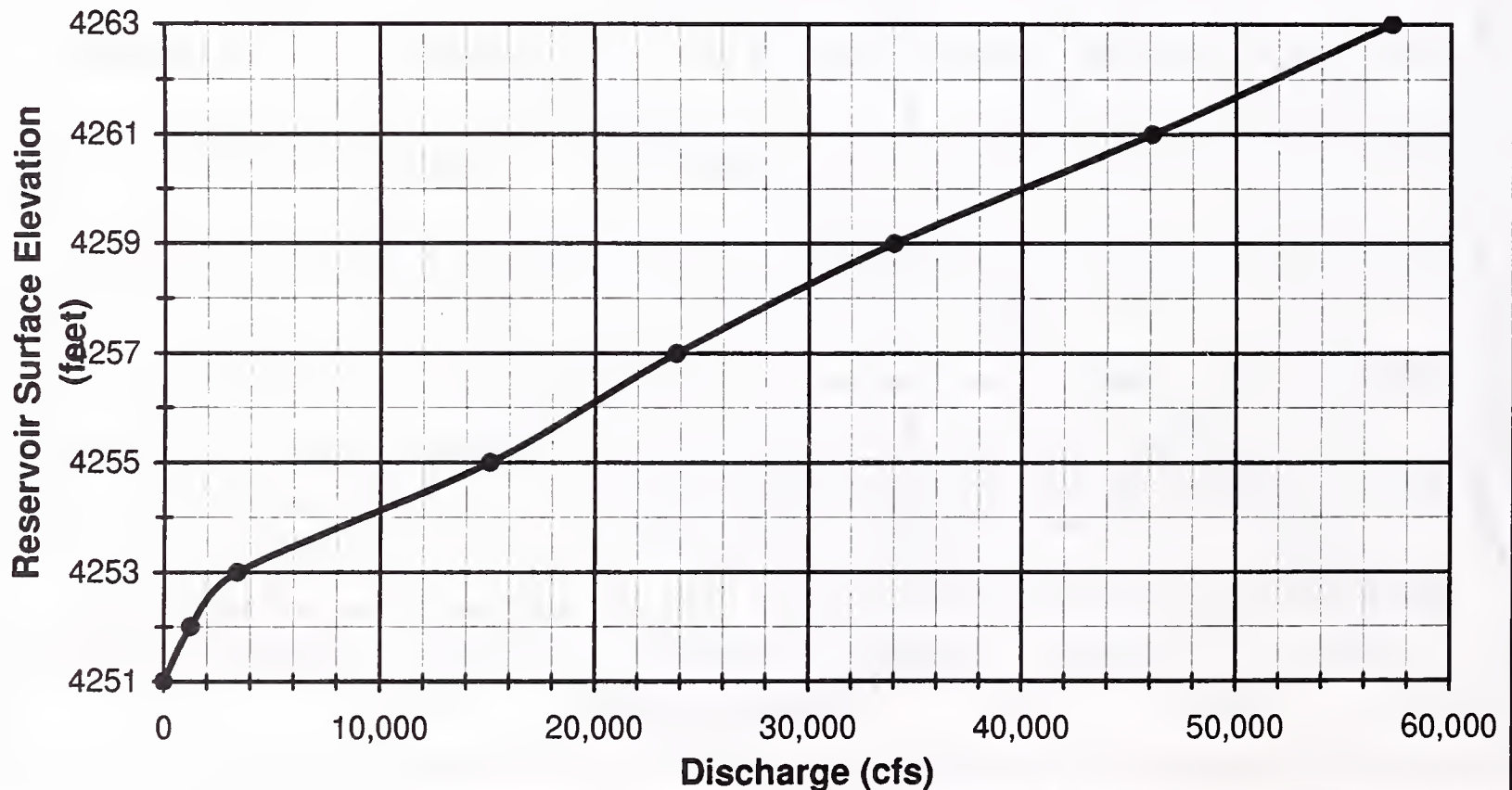
All flow controlled by guard dike. Top of guard dike = elevation 4251.0 feet.

**TABLE 8. COMBINED PRINCIPAL AND EMERGENCY
SPILLWAY DISCHARGE**

COONEY DAM

Reservoir Surface Elevation (feet)	Discharge (cfs)
4,251	0
4,252	1,235
4,253	3,400
4,255	15,100
4,257	23,800
4,259	34,000
4,261	46,100
4,263	57,300

**COMBINED PRINCIPAL AND EMERGENCY SPILLWAY
RATING CURVE
COONEY DAM**



Notes:

Data from HKM Associates January 1983.

Fuse plug washed out.

TABLE 9. MONUMENT AND CONTROL POINTS**COONEY DAM**

Station	Offset From Centerline Of Dam	As-Built Elevation	December 1982 Elevation	Description
MONUMENT POINTS				
13+03.6	65.35 Left	4,239.72	4,239.65	Top rebar in concrete
13+03.6	24.69 Left	4,260.03	4,259.96	Top rebar in concrete
15+02.1	144.29 Left	4,200.02	4,199.92	Top rebar in concrete
19+04.8	24.39 Left	4,260.05	4,260.01	Top rebar in concrete
20+05.2	64.57 Left	4,240.05	4,240.02	Top rebar in concrete
23+04.2	145.30 Left	4,199.97	4,199.90	Top rebar in concrete
23+04.6	25.47 Left	4,260.00	4,259.98	Top rebar in concrete
CONTROL POINTS				
3+00.0	0.0	4,271.99		BM - rebar in concrete
32+00.0	0.0	4,270.20		BM - rebar in concrete
27+93.5	69.0 left	4,254.84		TBM - rebar and cap

TABLE 10. OUTLET CHANNEL WEIR RATING TABLE

COONEY DAM

GAGE HEIGHT (ft)	DISCHARGE (cfs)		GAGE HEIGHT (ft)	DISCHARGE (cfs)		GAGE HEIGHT (ft)	DISCHARGE (cfs)
0.20	3.1		2.00	116.6		3.80	321.5
0.25	4.4		2.05	121.2		3.85	328.2
0.30	5.8		2.10	125.9		3.90	334.9
0.35	7.4		2.15	130.7		3.95	341.7
0.40	9.2		2.20	135.5		4.00	348.6
0.45	11.0		2.25	140.4		4.05	355.5
0.50	13.0		2.30	145.4		4.10	362.5
0.55	15.2		2.35	150.4		4.15	369.5
0.60	17.4		2.40	155.5		4.20	376.5
0.65	19.7		2.45	160.7		4.25	383.6
0.70	22.2		2.50	165.9		4.30	390.8
0.75	24.8		2.55	171.2		4.35	398.0
0.80	27.4		2.60	176.5		4.40	405.2
0.85	30.2		2.65	181.9		4.45	412.5
0.90	33.0		2.70	187.3		4.50	419.9
0.95	36.0		2.75	192.8		4.55	427.3
1.00	39.0		2.80	198.4		4.60	434.7
1.05	42.1		2.85	204.0		4.65	442.2
1.10	45.3		2.90	209.7		4.70	449.8
1.15	48.6		2.95	215.5		4.75	457.3
1.20	52.0		3.00	221.3		4.80	465.0
1.25	55.5		3.05	227.1		4.85	472.6
1.30	59.0		3.10	233.0		4.90	480.4
1.35	62.7		3.15	239.0		4.95	488.1
1.40	66.4		3.20	245.0		5.00	495.9
1.45	70.1		3.25	251.1		5.05	503.8
1.50	74.0		3.30	257.2		5.10	511.7
1.55	77.9		3.35	263.4		5.15	519.7
1.60	82.0		3.40	269.7		5.20	527.7
1.65	86.0		3.45	275.9		5.25	535.7
1.70	90.2		3.50	282.3		5.30	543.8
1.75	94.4		3.55	288.7		5.35	551.9
1.80	98.7		3.60	295.1		5.40	560.1
1.85	103.1		3.65	301.6		5.45	568.3
1.90	107.5		3.70	308.2		5.50	576.6
1.95	112.0		3.75	314.8		5.55	584.9
						5.60	593.2

Based on equation $Q = 39.0 + (H^{1.58})$

Calibrated 4/11/1983 by DNRC

APPENDIX C
INSPECTION REPORT FORM

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DAM SAFETY INSPECTION REPORT

NAME OF DAM _____
DATE INSPECTED _____

INVENTORY NO. _____
HAZARD CATEGORY _____
TYPE OF DAM _____
YEAR BUILT _____

OWNER _____
OPERATOR _____
STREAM _____
DRAINAGE AREA _____

Reservoir Storage Status

	Water Surface Elevation (feet)	Storage (acre-feet)
At time of inspection	_____	
At spillway crest	_____	
At min. dam crest elevation	_____	

ITEM	YES	NO	REMARKS
------	-----	----	---------

1. EMBANKMENT

A. Crest -- Height= Length= Width=

(1) Any visual settlements?			
(2) Any misalignments?			
(3) Any cracking?			
(4) Any traffic damage?			
(5) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

1. EMBANKMENT (continued)

B. Upstream Face -- Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Is riprap protection adequate?			
(5) Any stone deterioration?			
(6) Any visual settlement, slumps, sloughing, depressions or bulges?			
(7) Adequate grass cover?			
(8) Debris on the dam face?			
(9) Other?			

C. Downstream Face--Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Any visual settlement, slumps, sloughing, depressions or bulges?			
(5) Is the toe drain dry?			
(6) Are the relief wells flowing?			
(7) Any boils at the toe?			
(8) Any seepage areas?			
(9) Any traffic or animal damage?			
(10) Any burrowing animals?			
(11) Adequate grass cover?			
(12) Other?			

D. Amount and Type of Vegetation on the Dam

--

ITEM	YES	NO	REMARKS
------	-----	----	---------

2. ABUTMENT CONTACTS

A) Any erosion?			
B) Any visual differential movement?			
C) Any cracks?			
D) Any seepage present?			
E) Other?			

3. OUTLET WORKS

A. Intake Structure -- Size=

(1) Any settlement?			
(2) Any tilting?			
(3) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(4) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(5) Metal appurtenances:			
a. Any corrosion present?			
b. Any breakage present?			
(6) Trash rack?			
a. Condition?			
b. Anchor system secure?			
(7) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

B. Conduit -- Type = Size =

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Is the conduit metal?			
a. Any corrosion present?			
b. Protective coatings adequate?			
(4) Is the conduit misaligned?			
(5) Any calcium deposits?			
(6) Other?			

C. Gates and Tower

(1) Gates:			
a. Size: Operating:		Emergency:	
b. Type: Operating:		Emergency:	
(2) Controls operational?			
(3) Controls lubricated?			
(4) Operational problems?			
(5) Leakage around gates?			
(6) Condition of gate seals?			
(7) Any cavitation damage? If so, describe?			
(8) Describe air vent-size and condition.			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

C. Gates and Tower (continued)

(9) Is there a jet pump?			
a. Is it operational?			
b. Leakage?			
(10) Is the tower dry? ____ wet?			
(11) Any seepage in the tower?			
(12) Condition of the tower?			
(13) Any safety problems?			
(14) Ladder in good condition?			
(15) Condition of the gatehouse?			
(16) Emergency plan completed for the dam?			
a. Posted in the gatehouse?			
(17) Other?			

D. Stilling Basin

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Do energy dissipaters show:			
a. Signs of deterioration?			
b. Are they covered with debris?			
(4) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

E. Downstream Channel

(1) Is the channel:			
a. Eroding or backcutting?			
b. Sloughing?			
c. Obstructed?			
(2) Is released water:			
a. Undercutting the outlet?			
b. Eroding the embankment?			
(3) Other?			

4. SPILLWAY

A. Description

(1) Location?			
(2) Type of Spillway?			
(3) Size of Spillway?			
(4) Spillway lining?			
(5) Is there a weir?			
(6) Is the spillway in good condition?			
(7) Any drains?			
a. Describe the condition of drains.			

B. Does spillway show:

(1) Any cracking concrete?			
(2) Any spalling concrete?			
(3) Any exposed reinforcement in the concrete?			
(4) Any erosion?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

4. SPILLWAY (continued)

4. B. Does spillway show: (continued)

(5) Any slope sloughing?			
(6) Any obstructions?			
(7) Displacement or offset joints?			
(8) Loss of joint material?			
(9) Leakage at the joints?			
(10) Other?			

C. Do the energy dissipaters show:

(1) Signs of deterioration?			
(2) Any cracking?			
(3) Any spalling?			
(4) Any exposed reinforcement?			
(5) Are they covered with debris?			
(6) Other?			

D. Has release water:

(1) Eroded the embankment?			
(2) Undercut the outlet?			
(3) Eroded the downstream channel?			
(4) Other?			

E. Emergency Spillway

(1) Is there an emergency spillway?			(If YES, describe)

ITEM	YES	NO	REMARKS
------	-----	----	---------

5. RESERVOIR CONTROL

A) Recent upstream development?			
B) Recent downstream development?			
C) Slides in reservoir area?			
D) Change in reservoir operation?			
E) Large impoundment upstream?			
F) Any debris in the reservoir?			
G) Other?			

6. INSTRUMENTATION

A) List type(s) of instrumentation:			
B) In good condition?			
C) Read periodically?			
D) Is data available?			
E) Include all data gathered since last report.			

7. DOWNSTREAM CONDITION

A. Downstream Land Use.

--

This dam was inspected by:

Additional comments and recommendations.

APPENDIX D
DISTRIBUTION LIST

O&M DISTRIBUTION LIST

COONEY DAM

	<u>Number Of Copies</u>
1. State Water Projects Bureau Glen McDonald Greg Ames Art Taylor (2) Bob Arrington Bob Clark Delores Eustice	7
2. DNRC Information Services Section	1
3. DNRC Billings Regional Office Keith Kerbel Dave Adair	2
4. DNRC Dam Safety	1
5. Water Users Carl DeVries, Jr -- President Gary Sironen -- Vice President Clara Jarvi -- Secretary/Treasurer	3
6. Dam Operator Dam Operator (Jeffrey Krook) Assistant Dam Operator (Frank Ropp) Gate House	3
7. State Library -- Attn: Roberta Gebhardt	4
8. Extra	2
=====	
TOTAL	23

APPENDIX E
MONITORING WELL LOGS

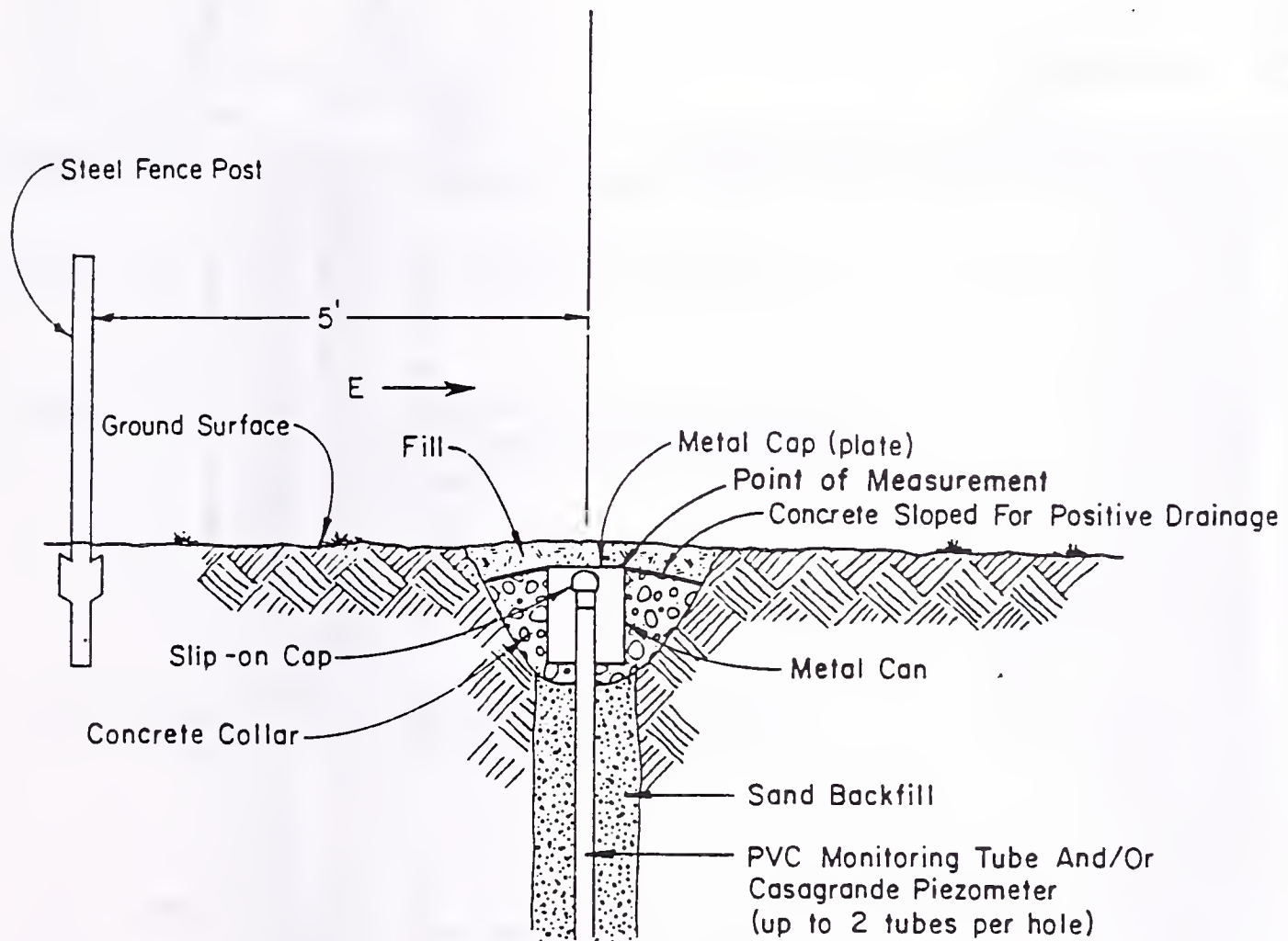
MONITORING WELLS

<u>Well No.</u>	<u>Type and Location of Well</u>
301	Observation well (white casing) North side of baffled drop
302	Observation well (white casing) Dam crest -- left abutment
303-O	Observation well (white casing) Dam crest -- foundation bedrock
303-P	Casagrande piezometer (gray casing) Dam crest -- embankment phreatic surface
304	Observation well (white casing) Downstream toe near collector drains
305	Slope inclinometer (blue casing) Dam crest -- embankment
306	Casagrande piezometer (gray casing) Dam crest -- embankment
307	Slope inclinometer (blue casing) Right abutment
308	Observation well (white casing) Downstream area near trench drain

PLATE NO. 4

COMPLETED

CONCRETE COLLAR AND CAP FOR DRILL HOLES

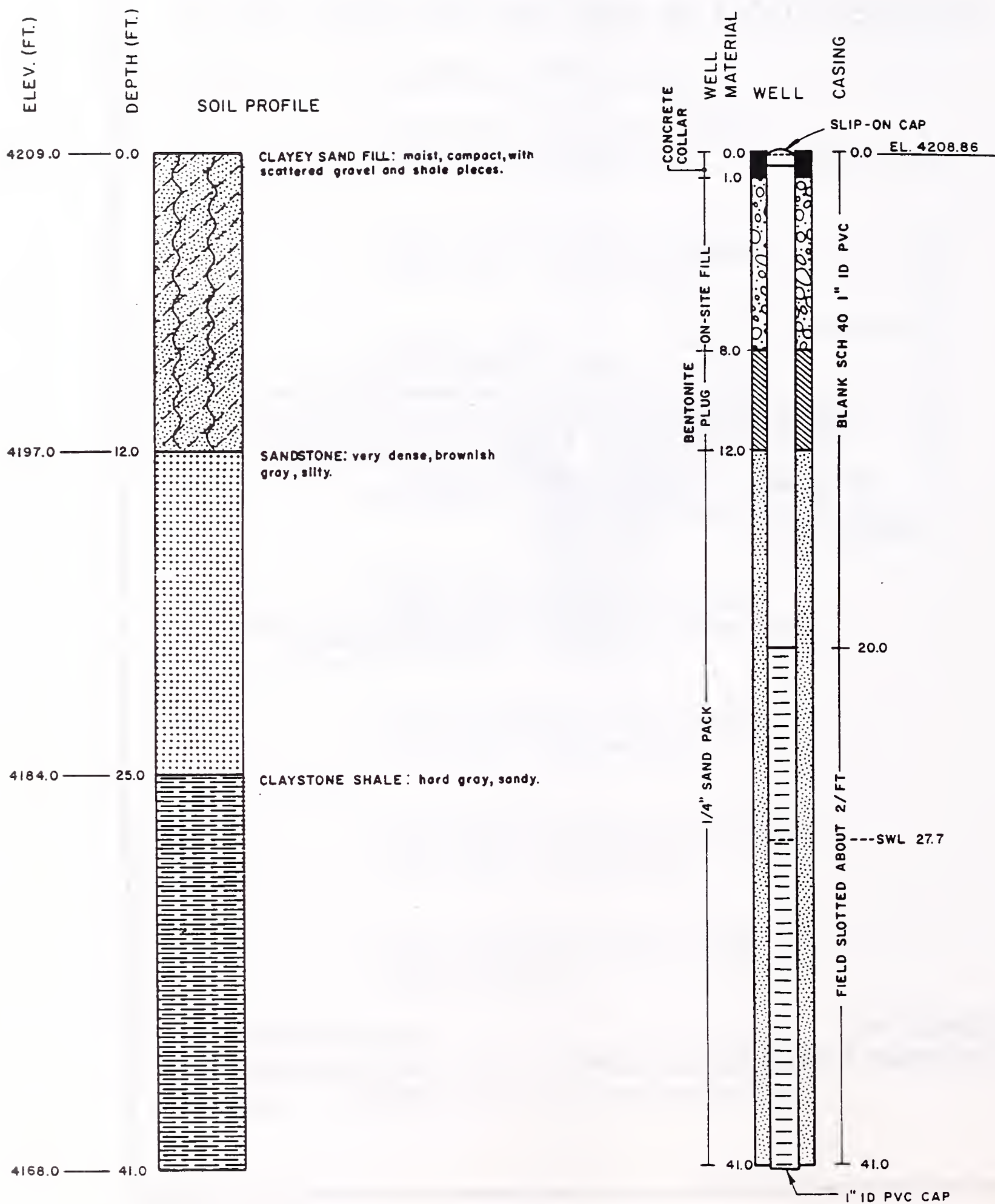


COONEY DAM
MONITORING SYSTEM INSTALLATION

HKM ASSOCIATES
BILLINGS, MONTANA
MARCH 1983

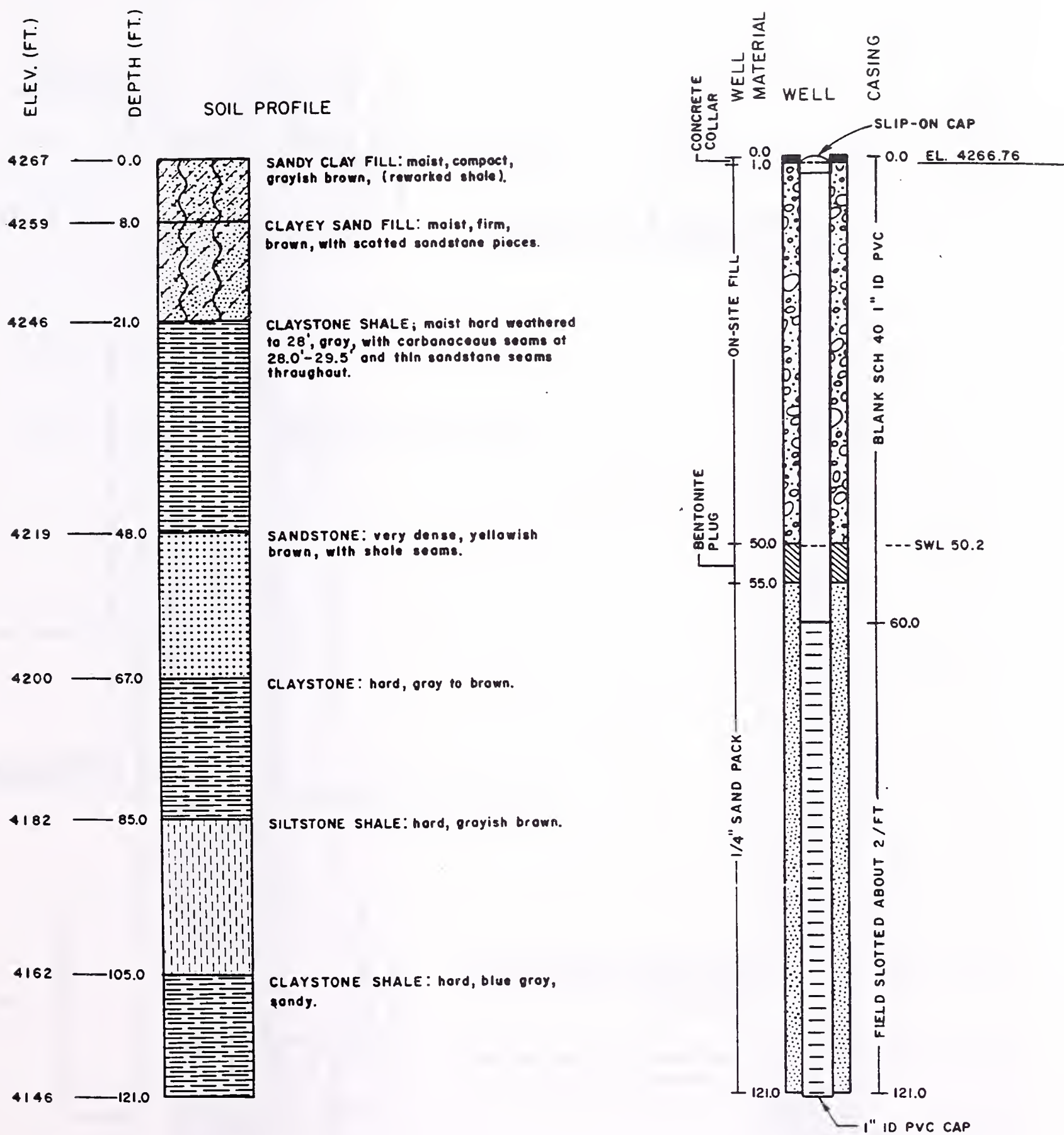
DRILL HOLE NO. 301 (DH-301)

Observation Well (white casing)



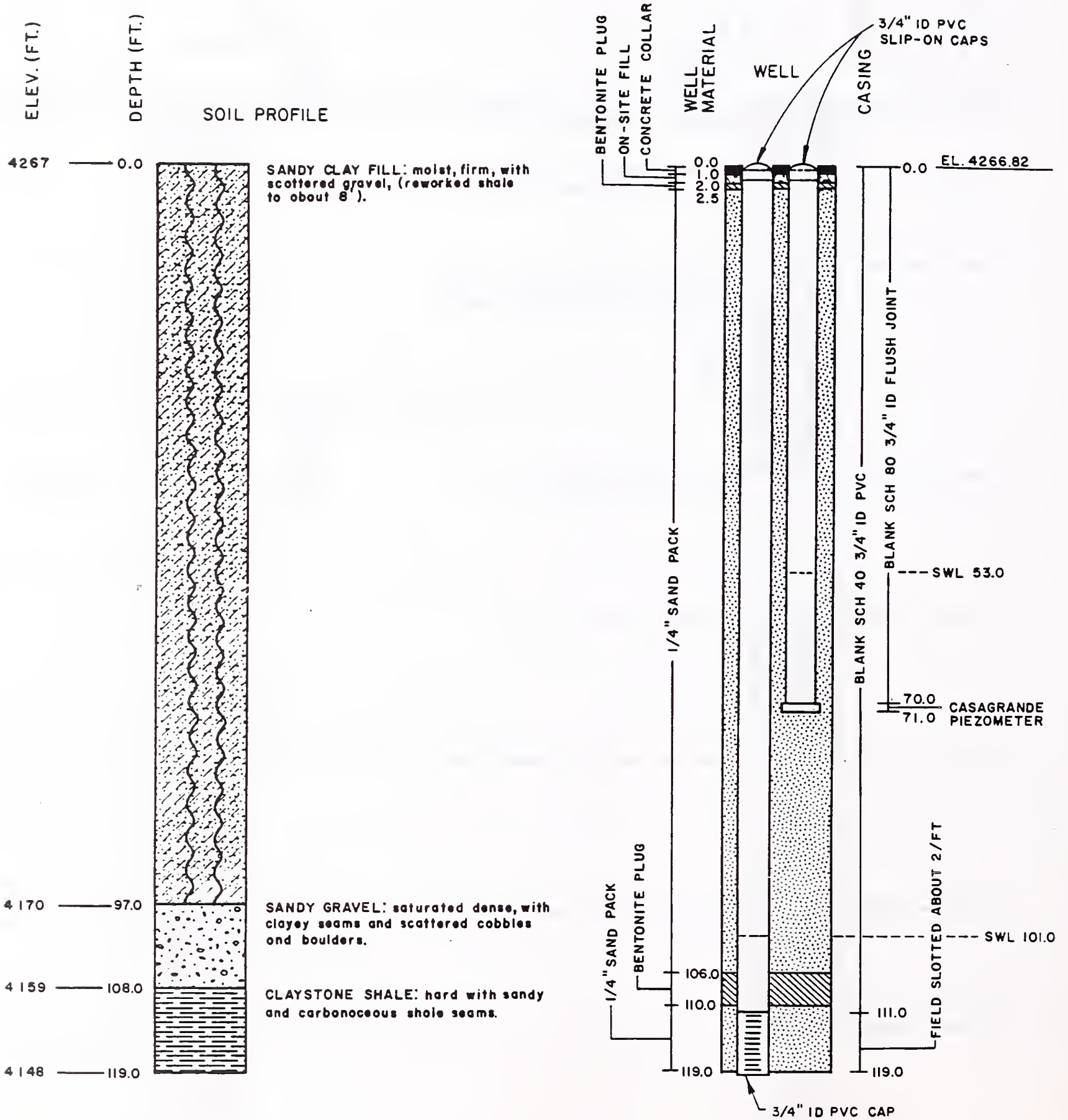
DRILL HOLE NO. 302 (DH-302)

Observation Well (white casing)



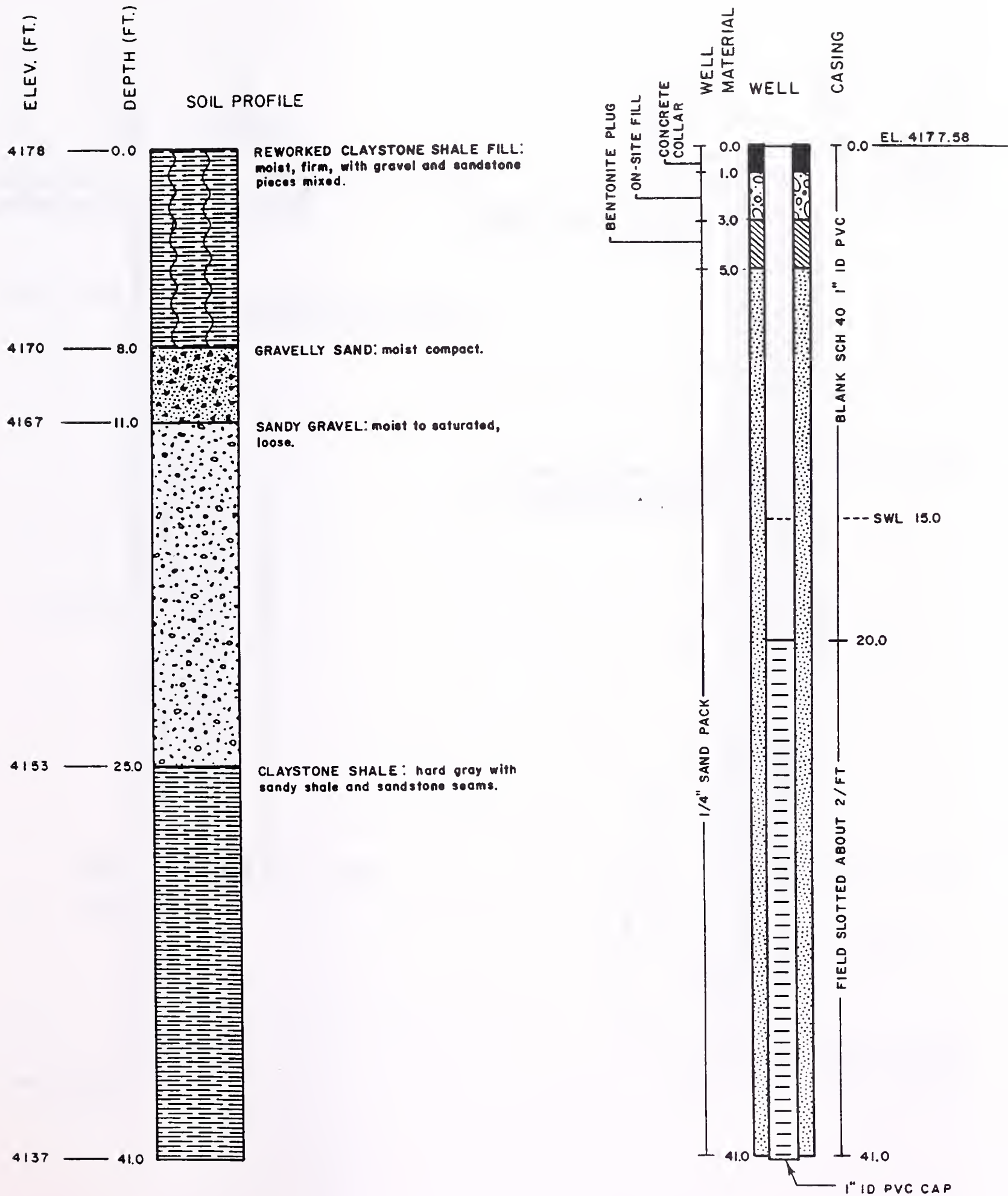
DRILL HOLE NO. 303 (DH-303)

Observation Well (white casing)
Casagrande Piezometer (gray casing)



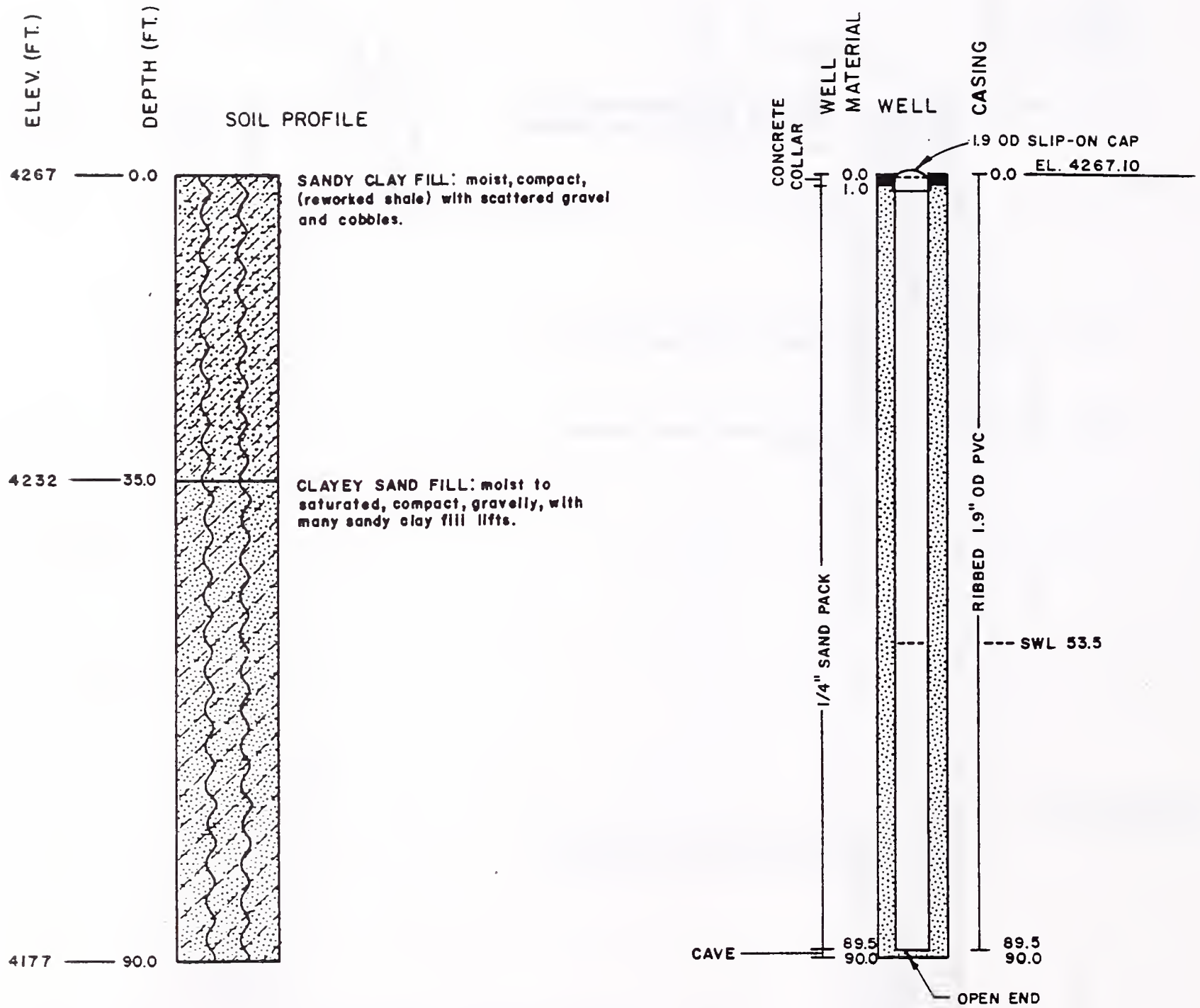
DRILL HOLE NO. 304 (DH-304)

Observation Well (white casing)



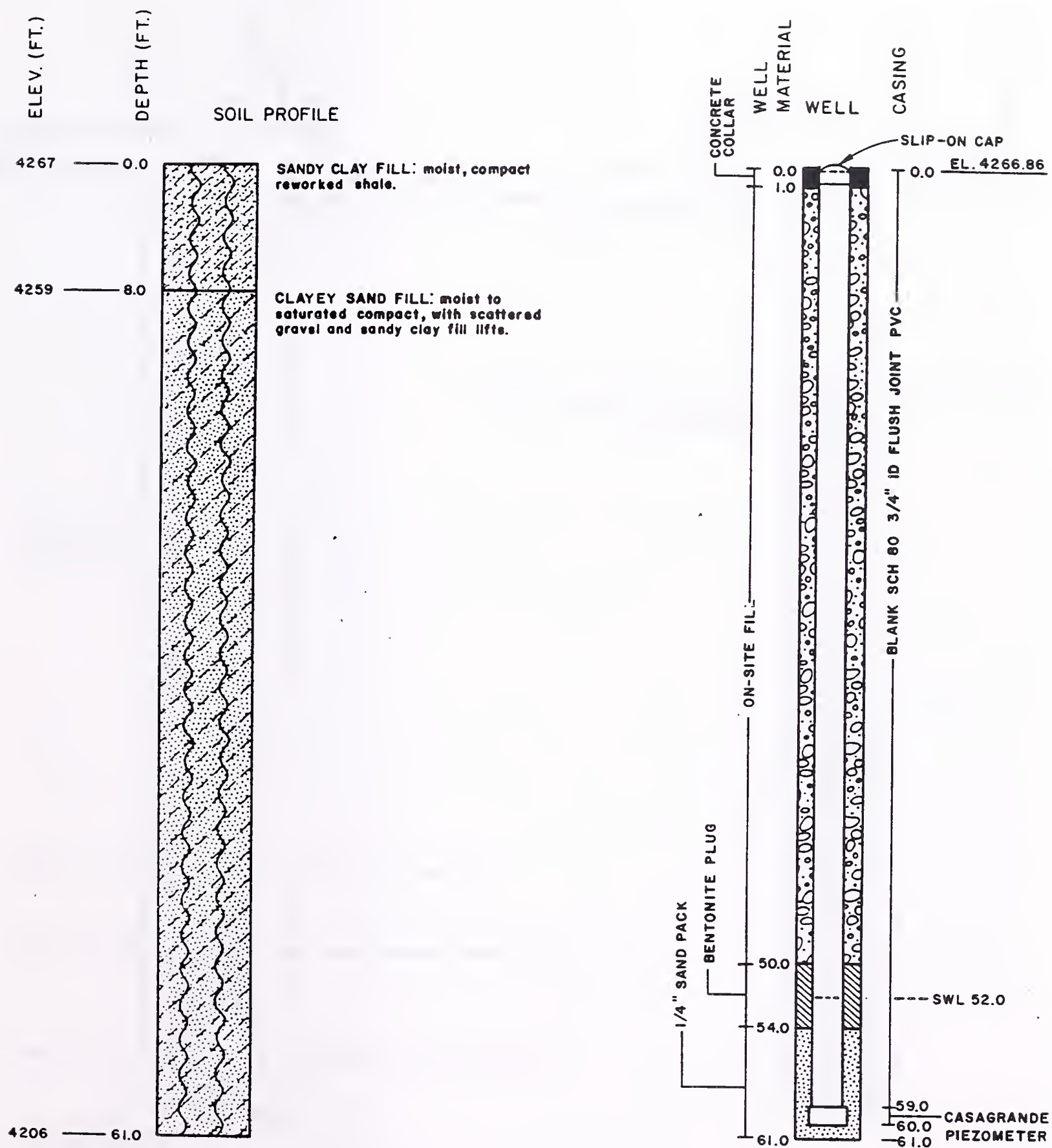
DRILL HOLE NO. 305 (DH-305)

Slope Inclinometer (blue casing)



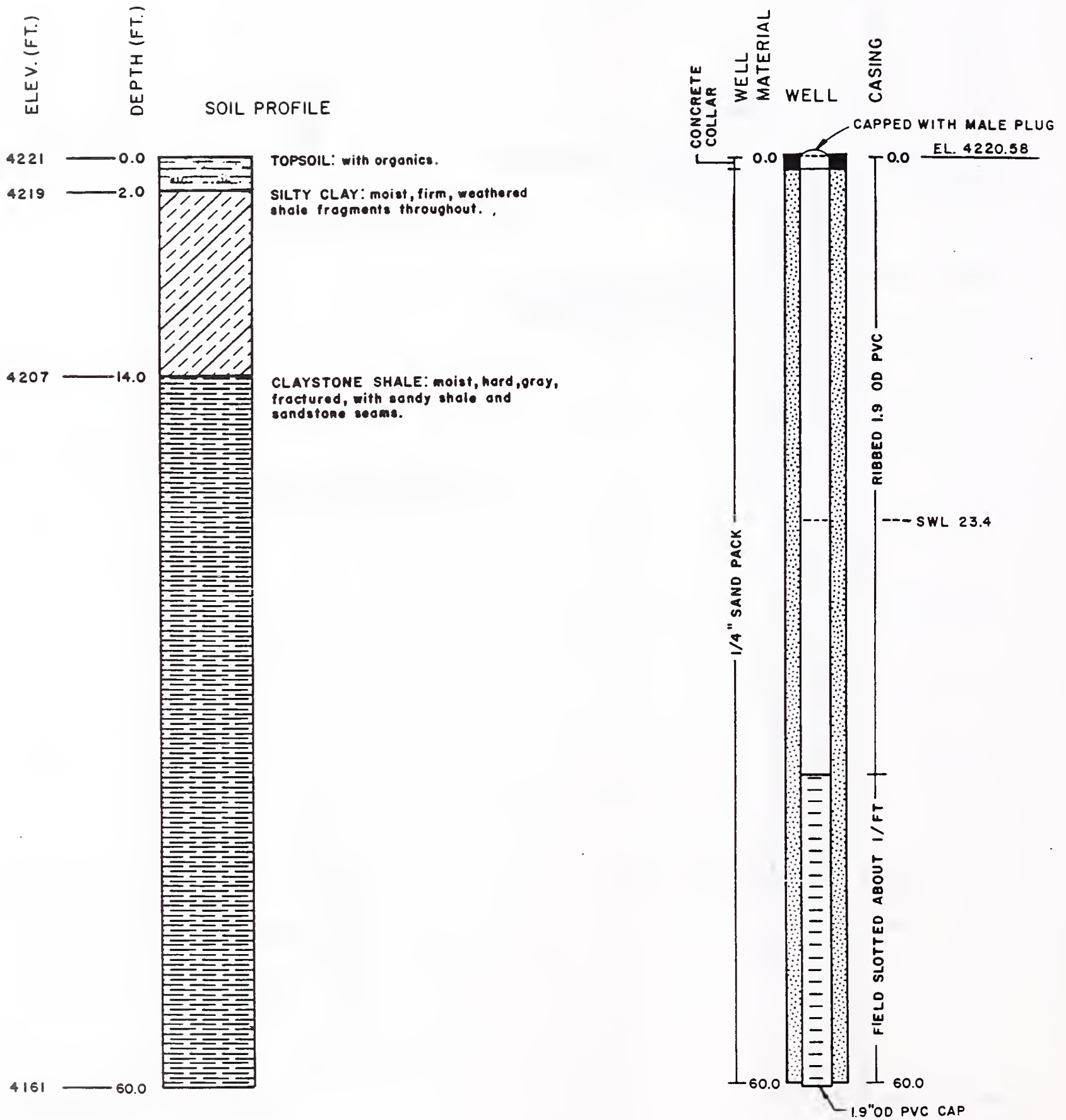
DRILL HOLE NO. 306 (DH-306)

Casagrande Piezometer (gray casing)



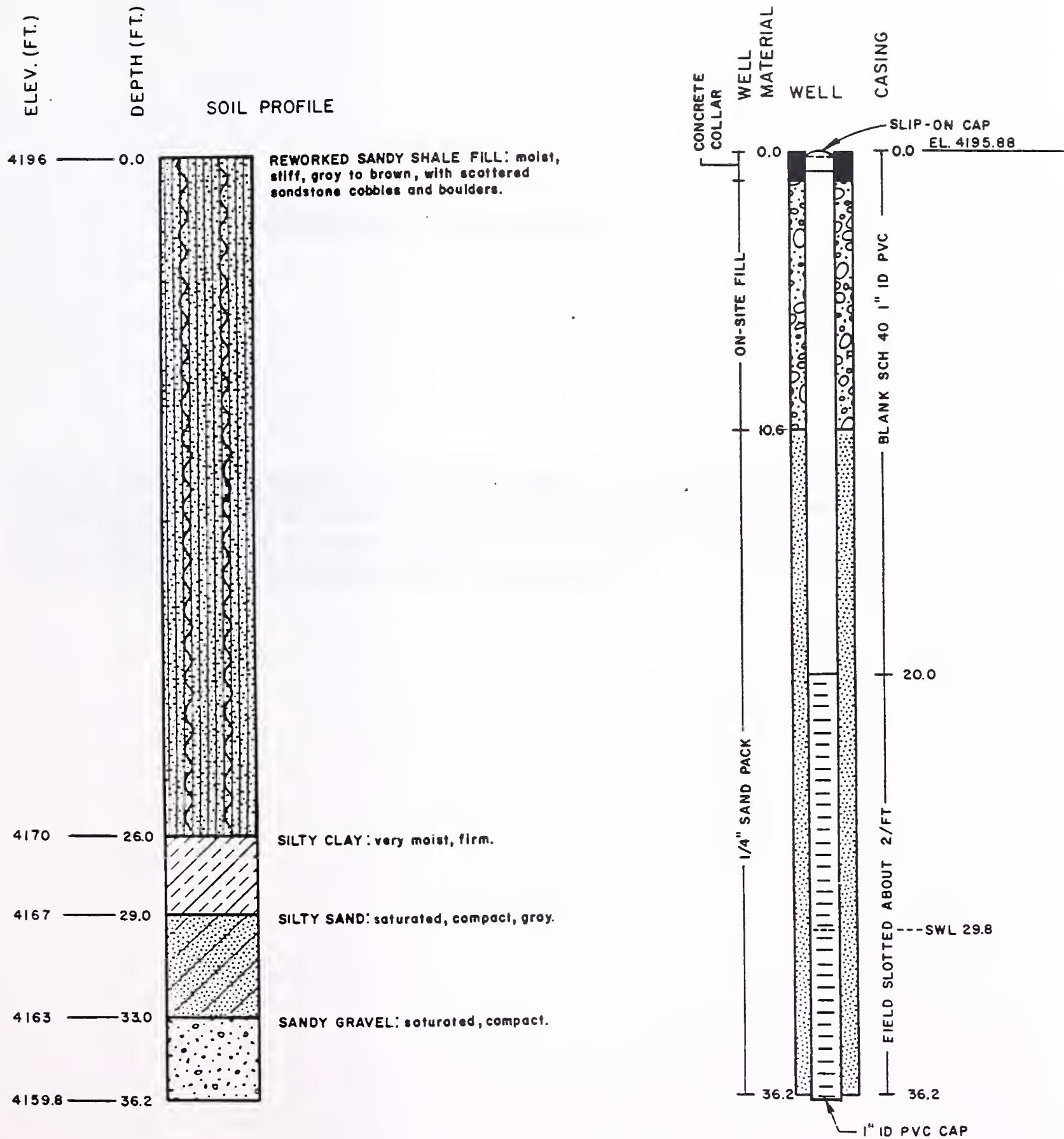
DRILL HOLE NO. 307 (DH-307)

Slope Inclinator (blue casing)



DRILL HOLE NO. 308 (DH-308)

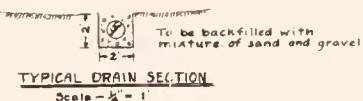
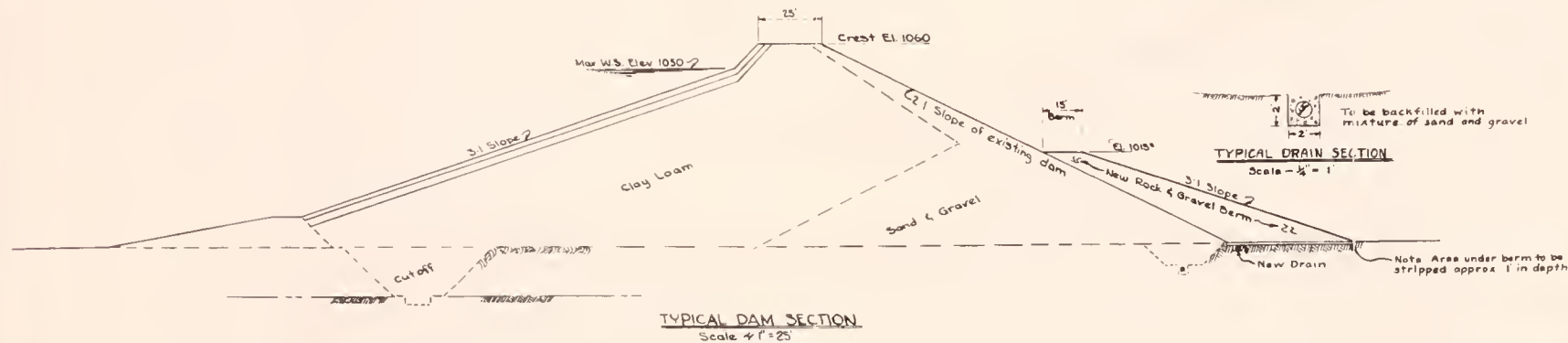
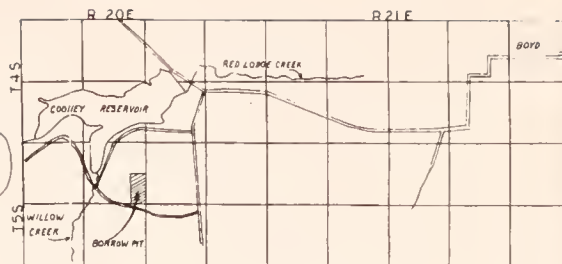
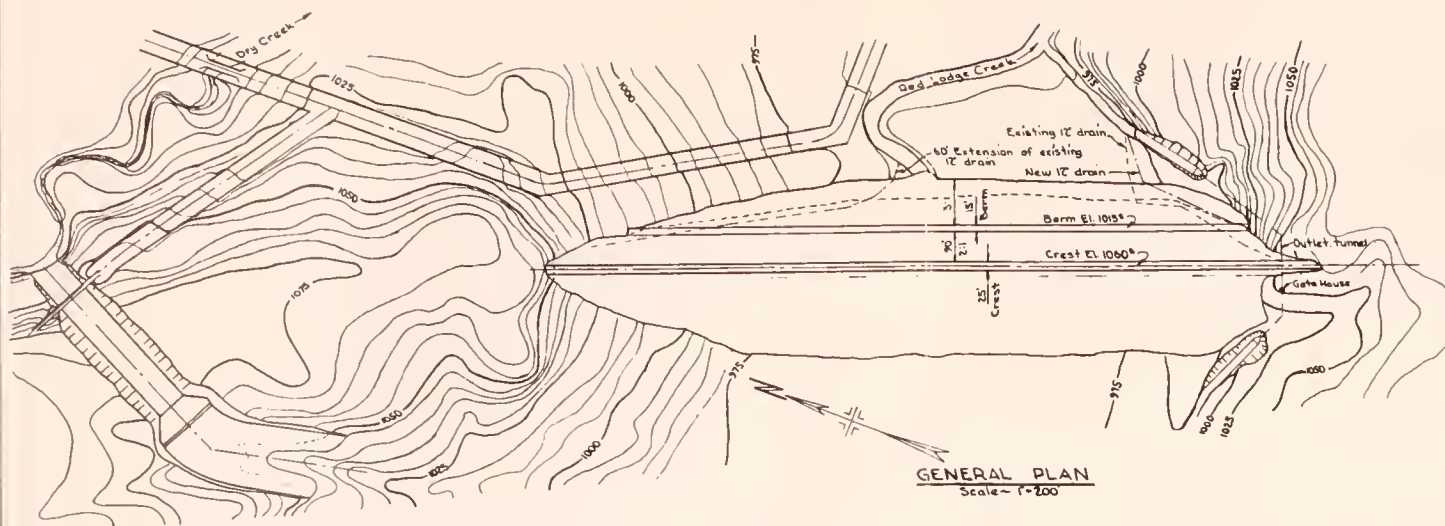
Observation Well (white casing)



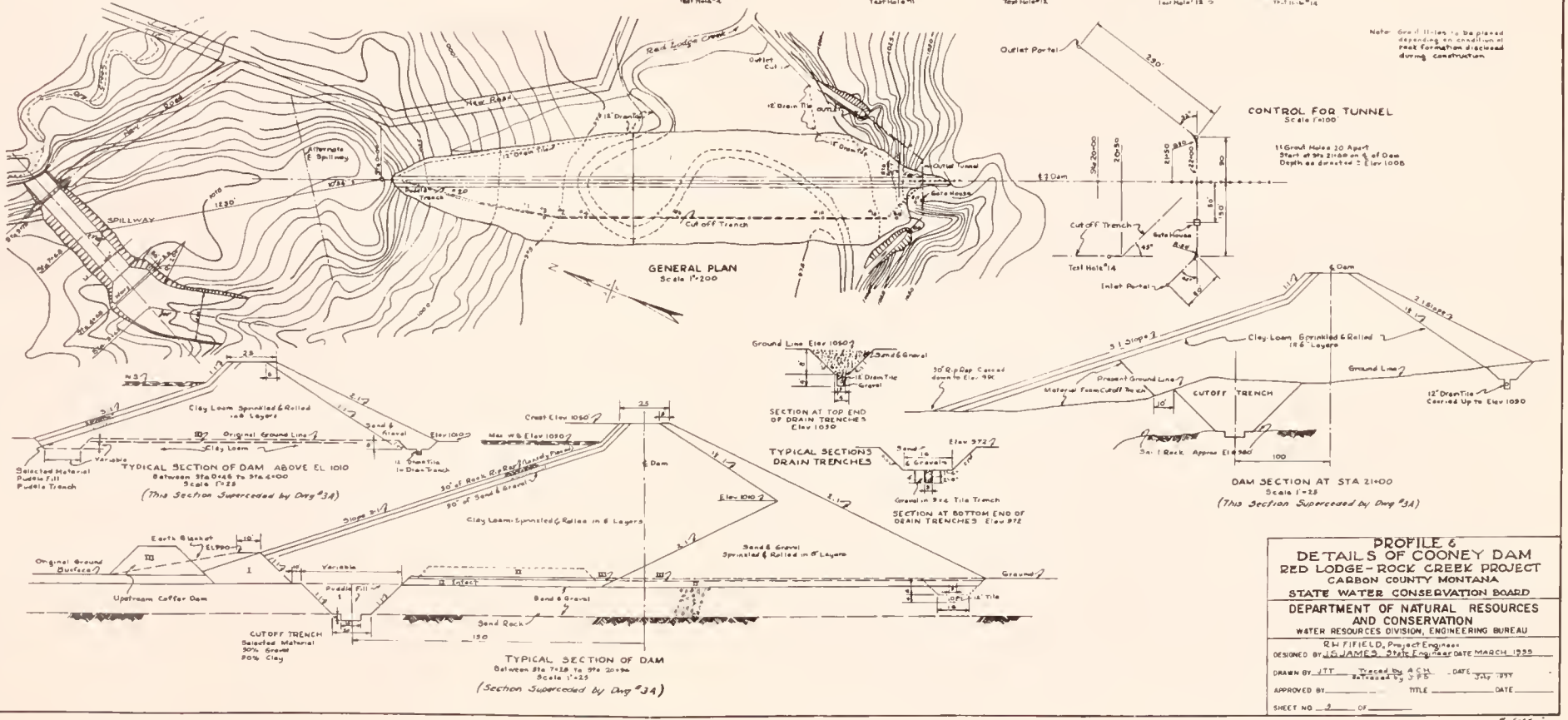
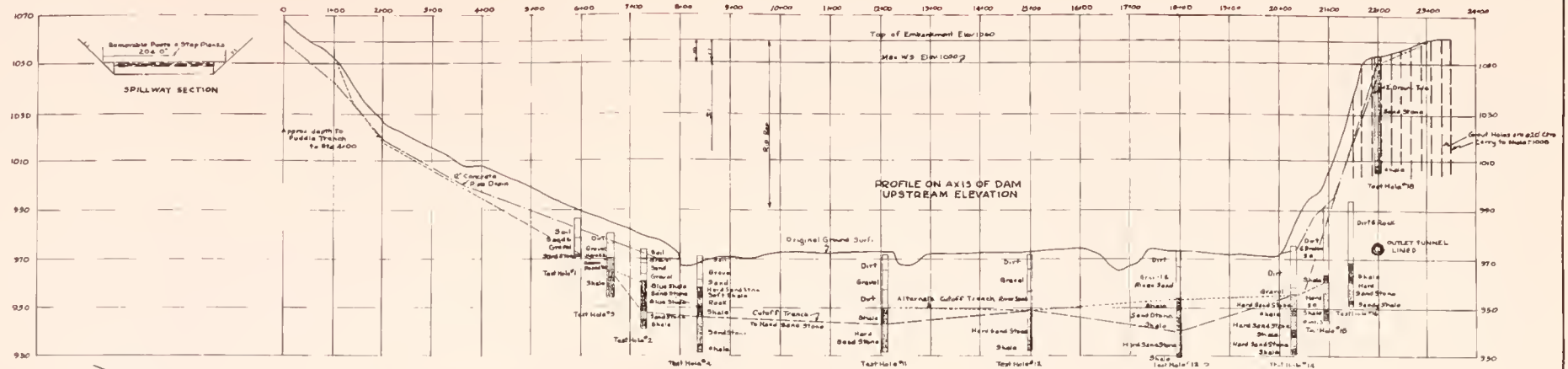
APPENDIX F

PROJECT DRAWINGS

(NOTE: Reduced project drawings, pages F3 - F15, are design drawings and not "As Builts", and should be used for reference only. The 1981 drawings, pages F17 - F53, are "As-Builts". The SWPB has the full size project drawings.)



GRAVEL & ROCK BERM
COONEY DAM
CARBON COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONT. MAY 1962
Scale - As Shown

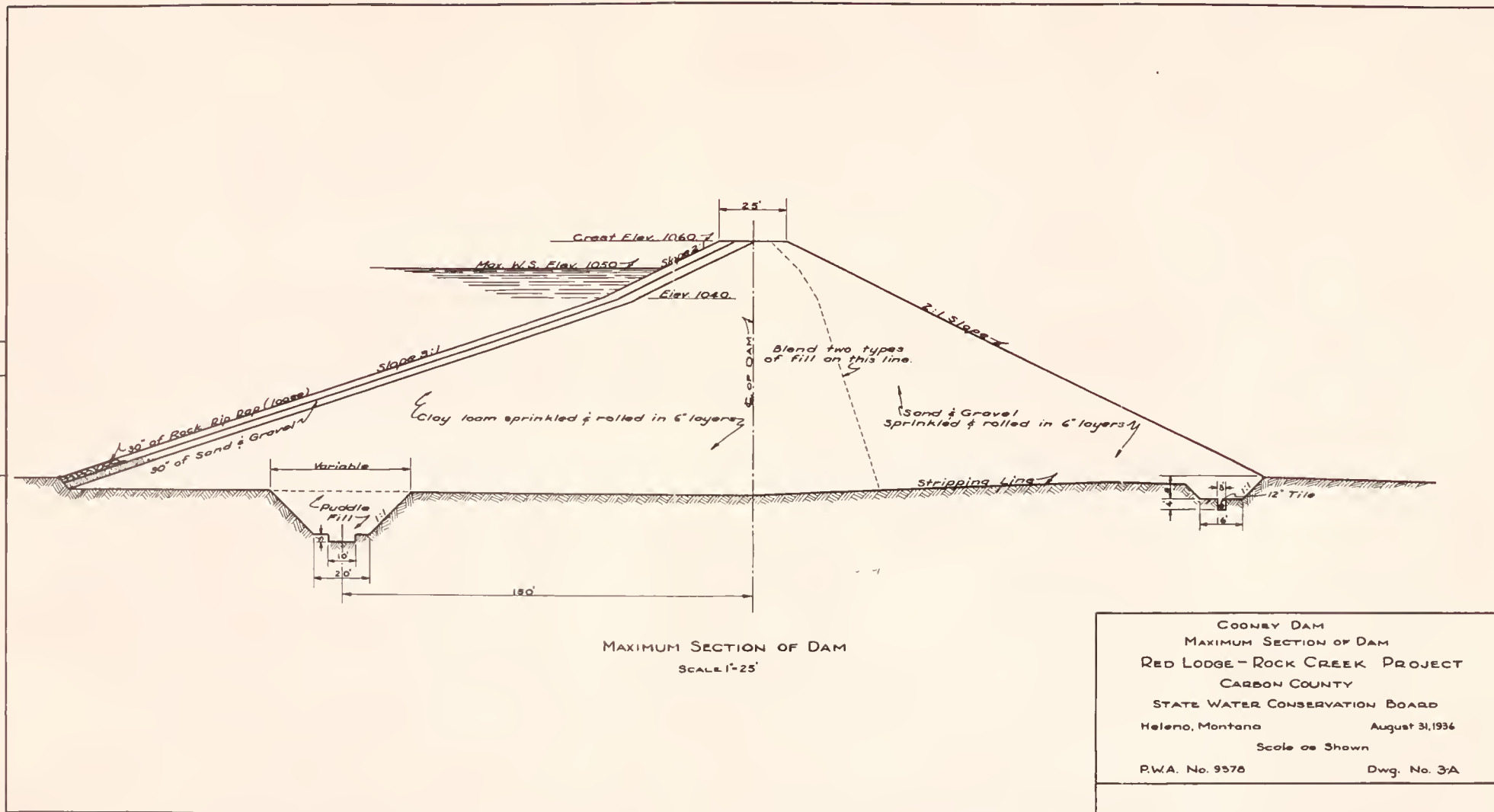


PROFILE 6
DETAILS OF COONEY DAM
 RED LODGE-ROCK CREEK PROJECT
 CARBON COUNTY MONTANA
 STATE WATER CONSERVATION BOARD
 DEPARTMENT OF NATURAL RESOURCES
 AND CONSERVATION
 WATER RESOURCES DIVISION, ENGINEERING BUREAU

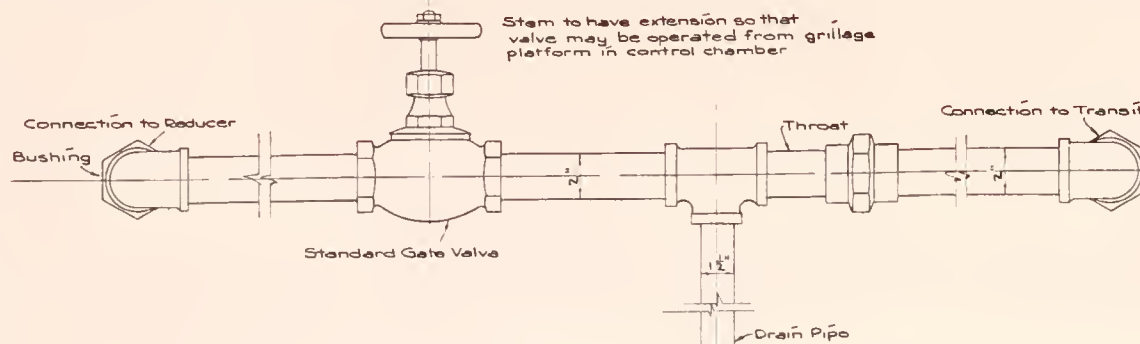
RH FIELD, Project Engineer
 DESIGNED BY J. JAMES, State Engineer DATE MARCH, 1935

DRAWN BY JTT Checked by ACH DATE MAY 1935
 APPROVED BY [Signature] TITLE [Signature] DATE [Signature]

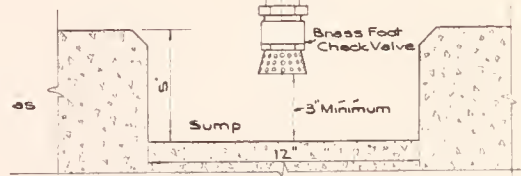
SHEET NO. 2 OF 2



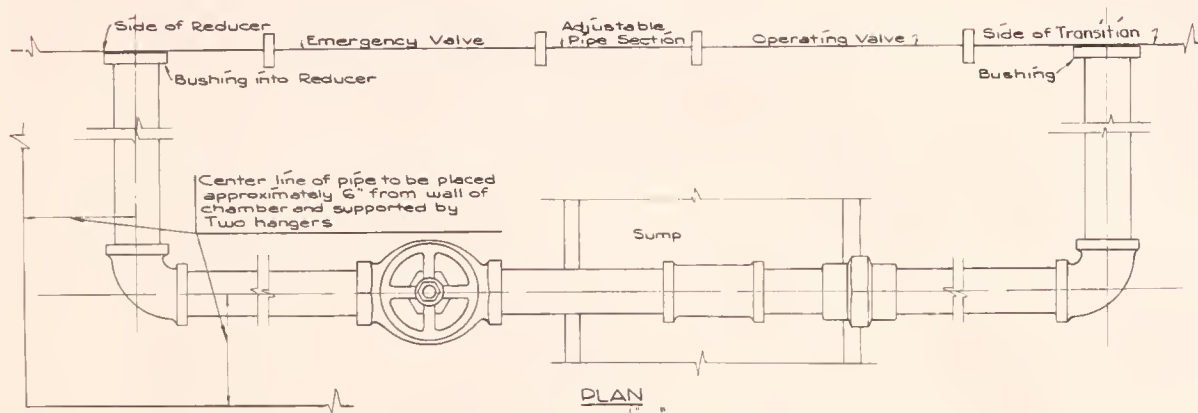
#5-46-B



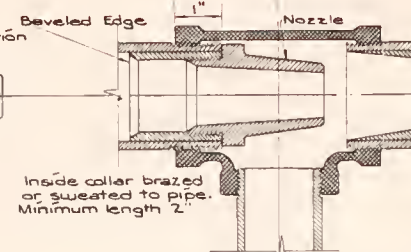
Note
Pipe and all fittings to be extra strong galvanized.
Sump to be located in chamber as directed by the engineer.



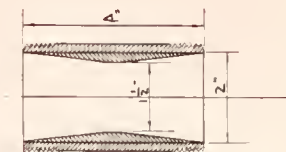
ELEVATION
SCALE $\sim \frac{1}{4} = 1"$



PLAN
SCALE $\sim \frac{1}{4} = 1"$

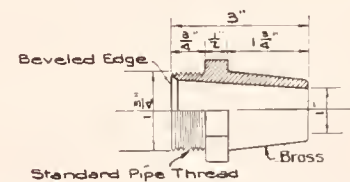


SECTION THROUGH TEE
SCALE $\sim \frac{1}{2} = 1"$

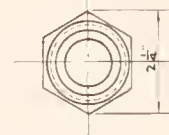


Throat to be made by filling with brazing metal

SECTION THROUGH THROAT
SCALE $\sim \frac{1}{2} = 1"$



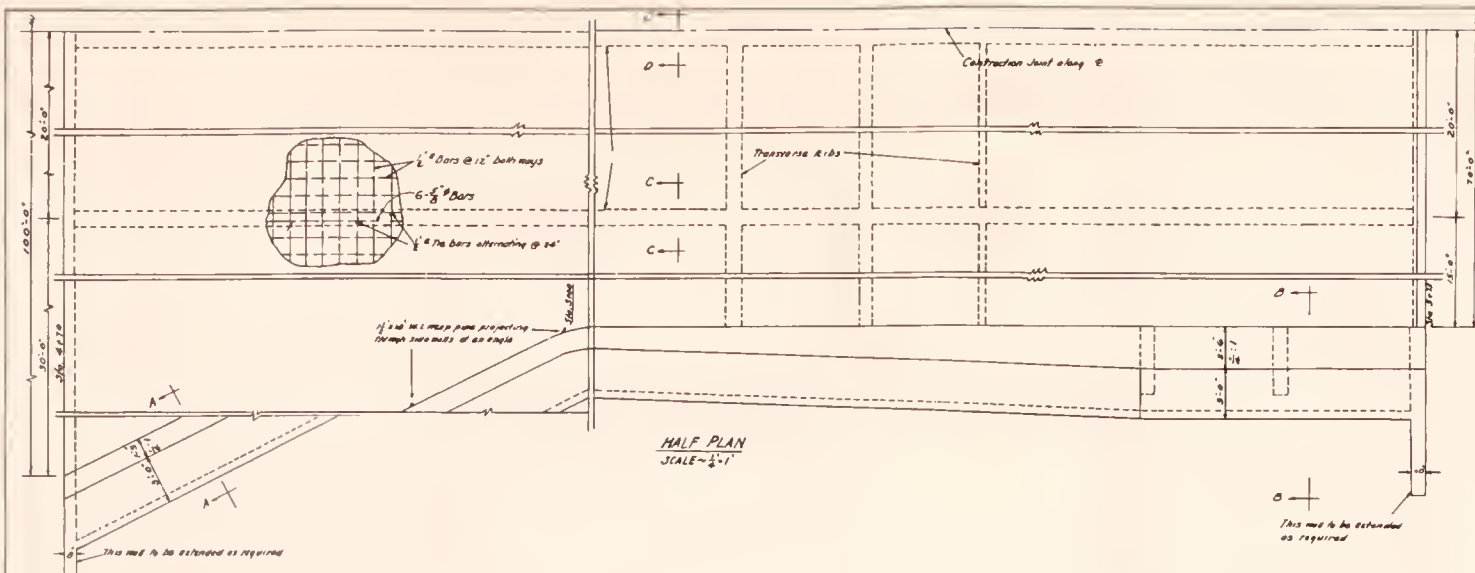
NOZZLE DETAIL
SCALE $\sim \frac{1}{2} = 1"$



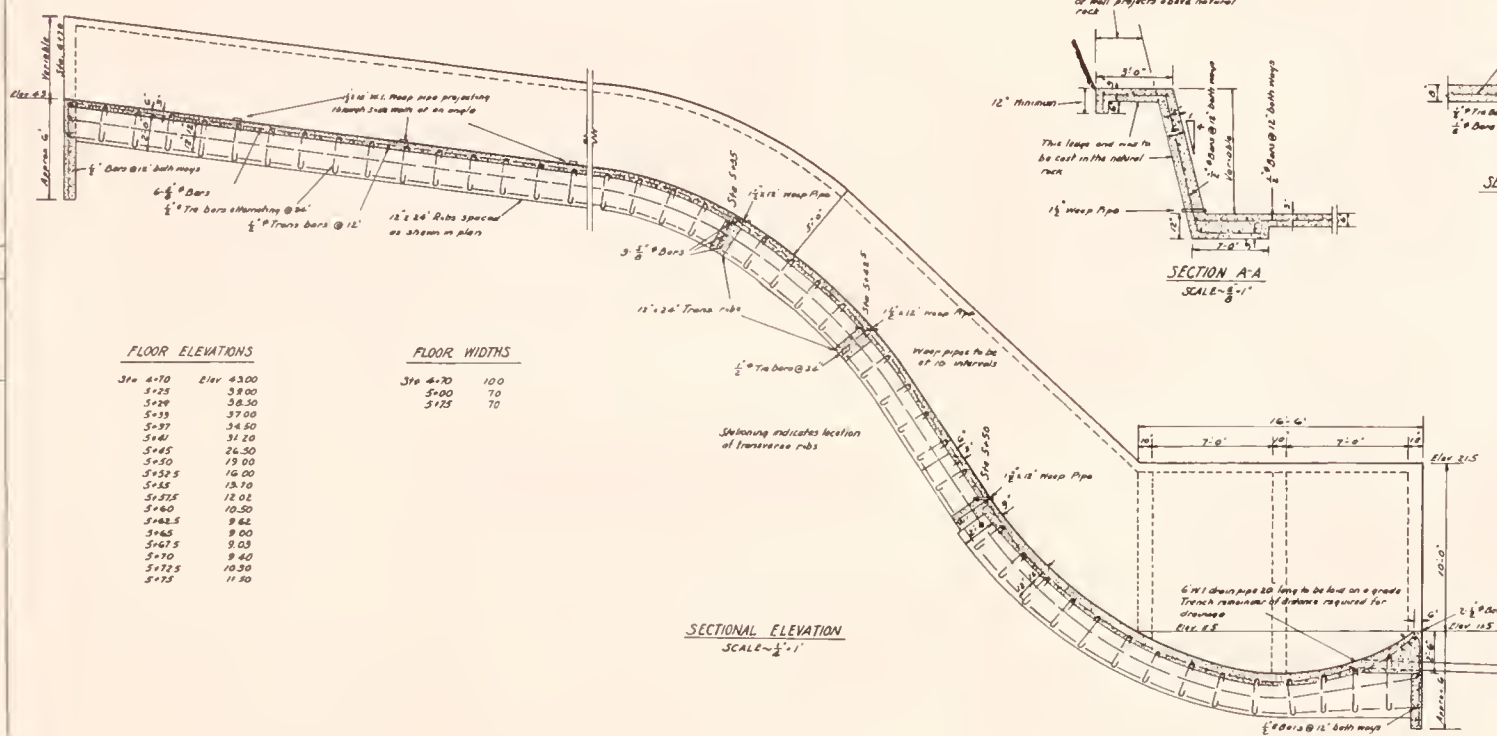
STANDARD JET PUMP
FOR SUMP DRAINAGE
STATE WATER CONSERVATION BOARD
HELENA, MONTANA OCT. 31, 1935
SCALE AS SHOWN

DWG. S-10

Drawn by	WVJ	Checked by	GFS		
Traced by	UCK				



HALF PLAN
SCALE - $\frac{1}{8}'' = 1'$



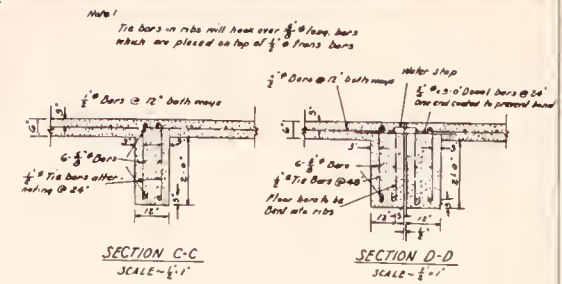
SECTIONAL ELEVATION
SCALE - $\frac{1}{8}'' = 1'$

FLOOR ELEVATIONS

Sta	Elev
4+70	43.00
5+25	39.00
5+29	38.50
5+33	37.00
5+37	34.50
5+41	31.20
5+45	26.50
5+50	19.00
5+52.5	16.00
5+55	13.70
5+57.5	12.02
5+60	10.50
5+62.5	9.62
5+65	9.00
5+67.5	9.03
5+70	9.40
5+72.5	10.30
5+75	11.30

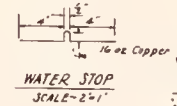
FLOOR WIDTHS

Sta	4+70	5+00	5+75
100			
70			
70			

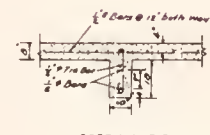


SECTION C-C
SCALE - $\frac{1}{2}'' = 1'$

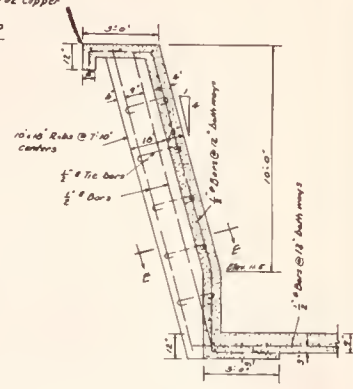
SECTION D-D
SCALE - $\frac{1}{2}'' = 1'$



WATER STOP
SCALE - $2'' = 1'$



SECTION E-E
SCALE - $\frac{1}{2}'' = 1'$

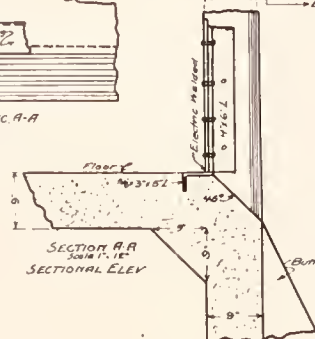
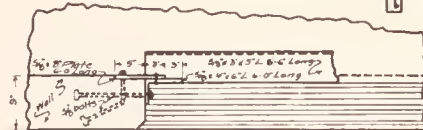
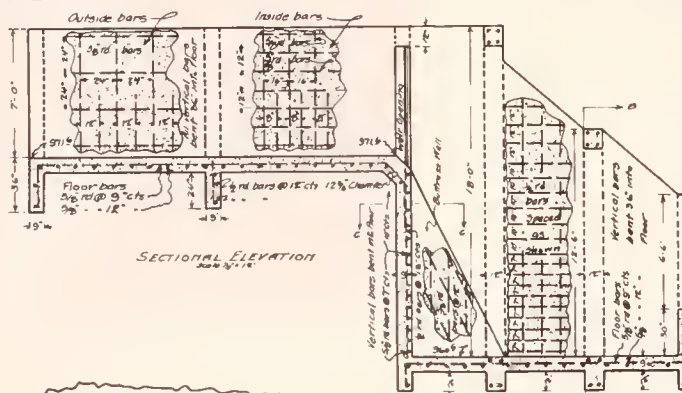
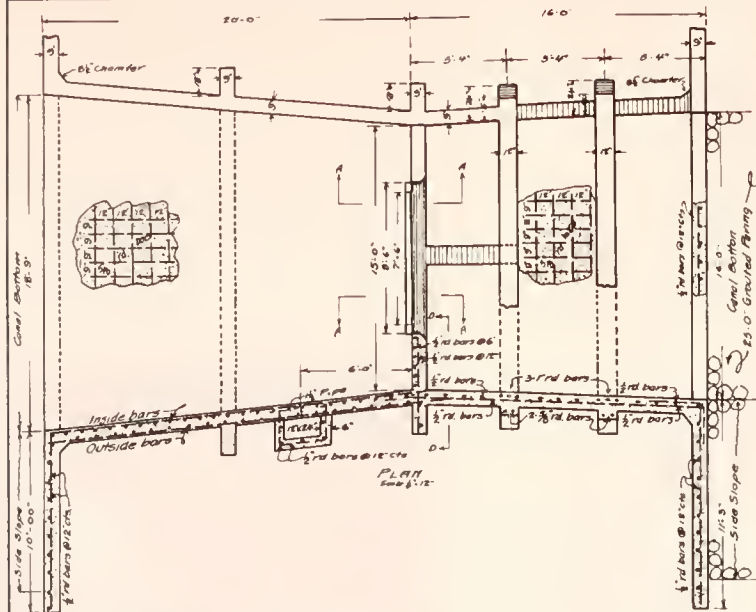


SECTION B-B
SCALE - $\frac{1}{2}'' = 1'$

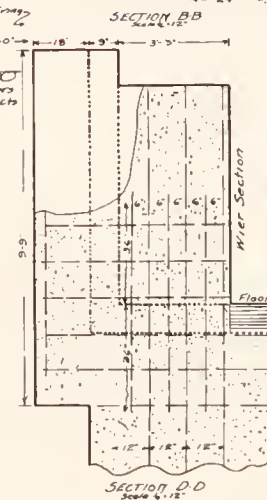
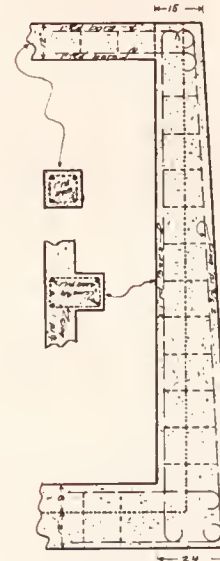
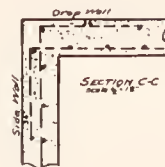
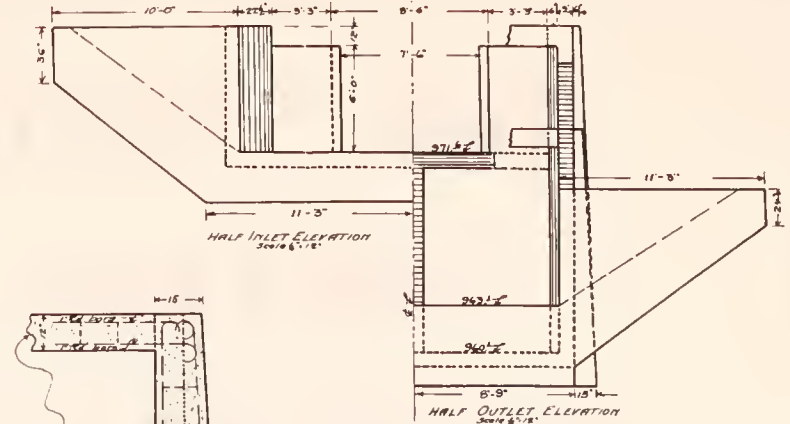
GENERAL NOTES

All concrete edges to be chamfered $1\frac{1}{2}''$.
Reinforcing steel to be placed a maximum distance of 3" from surface of concrete unless otherwise shown.
Reinforcing steel in vertical rods to be bent into and ready 2d" to bottom band.
Reinforcing steel to lap at least 40 diameters and be wrapped with tying wire. Bonds in reinforcing bars shall be made to a radius of not less than four diameters of the bar.
Contraction joints to be filled with a non-fluor asphaltic material.
Contraction joints to be carried through entire structure with dowel bars, and water stop for entire length of joint as shown in details.
Sections of copper water stop in contraction joints to be soldered or caulked in such a manner as to make a continuous water-tight joint.
Where subgrade projects above natural rock they are to be as shown in SECTION A-A except that top horizontal ledge will be omitted.

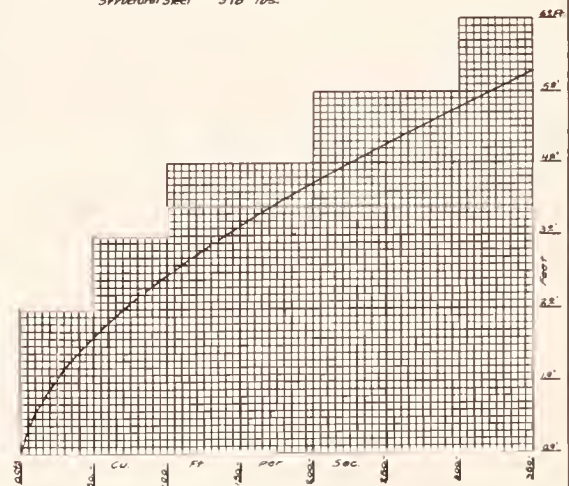
SPILLWAY DROP
RED LODGE-ROCK CREEK STORAGE PROJECT
CARBON COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONTANA. AUGUST 4, 1937.
SCALE AS SHOWN
DRAWING NO. 9
PWA NO. MONT. 9378-X
Checked by F. M. R.



WEIR DETAIL

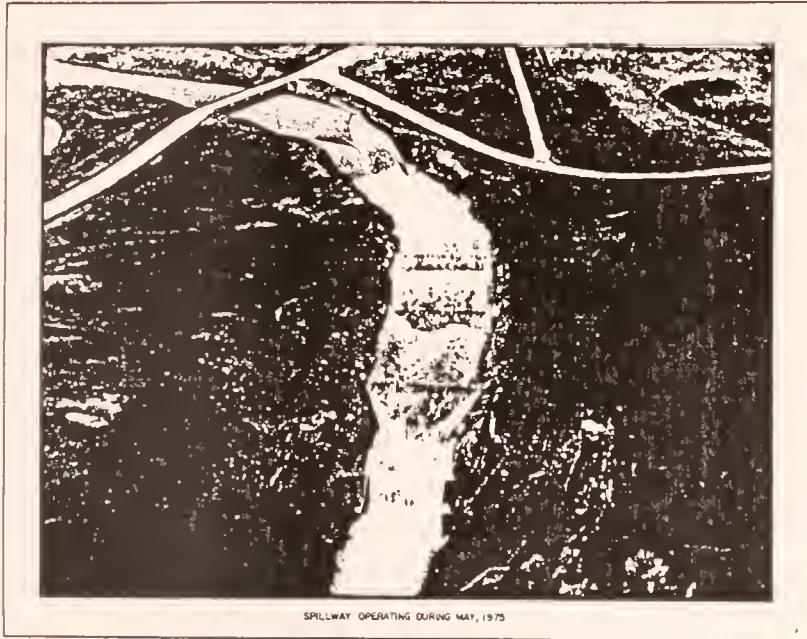


QUANTITIES.	
Concrete	59 cu. yds.
Grouted Paving	100 sq. yds.
Reinforcement	7801 lbs.
Structural Steel	578 lbs.



RED LODGE-ROCK CREEK PROJECT
CARBON COUNTY, MONT.
MONTANA WATER CONSERVATION BOARD
DROP & N. R. COONEY DAM
P.W.A. No. 9378X
March 1976

COONEY DAM SPILLWAY REHABILITATION



SPILLWAY OPERATING DURING MAY, 1975

MONTANA DEPARTMENT
OF
NATURAL RESOURCES AND CONSERVATION

JULY, 1981

AS BUILT - 1982
E.H. OFTEDAL & SONS - GENERAL
CONSTRUCTION - SUB
JENSEN DRILLING - SUB.
REVIEWED BY: R.J. PERKINS 12-13-82

APPROVED BY:

Richard P. Bond
CHIEF, ENGINEERING BUREAU
MONTANA DEPARTMENT OF
NATURAL RESOURCES AND CONSERVATION

APPROVED BY:

G. J. Krasich
PRESIDENT, HKM ASSOCIATES

PREPARED BY:

HKM ASSOCIATES
PROJECT NO. 8M087.107

5-64-32

INDEX OF DRAWINGS

SHEET NO. _____ TITLE _____

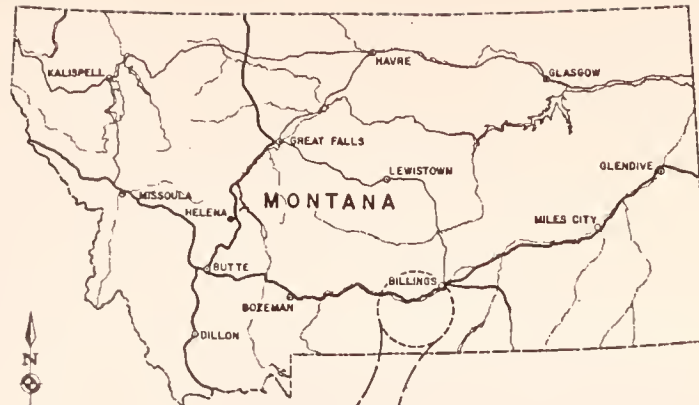
1. SHEET INDEX - LOCATION MAP
2. GENERAL LAYOUT
3. PLAN OF DAM
4. FOUNDATION PLAN AND PROFILE
5. TYPICAL DAM CROSS SECTIONS
6. EMBANKMENT DETAILS
7. PLAN OF AUXILIARY AND PRINCIPAL SPILLWAY
8. AUXILIARY SPILLWAY PROFILE AND SECTIONS
9. AUXILIARY SPILLWAY SECTIONS
10. ROAD PLAN AND PROFILE
11. PRINCIPAL SPILLWAY PROFILE
12. TYPICAL PRINCIPAL SPILLWAY CROSS SECTIONS
13. OGEE CREST, CHANNEL LINING
14. BRIDGE PLAN AND PROFILE
15. BRIDGE DETAILS
16. BAFFLED DROP DETAILS
17. MISCELLANEOUS DETAILS
18. GEOLOGIC INFORMATION

GENERAL NOTES:

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL.
2. ALL STATIONING REFERS TO CENTERLINE (CL) OF CONSTRUCTION AND IS MEASURED HORIZONTAL DISTANCE.
3. QUANTITIES ARE FOR BID PURPOSES ONLY.
4. CONTRACTOR WILL BE RESPONSIBLE FOR THE FURNISHING AND PLACING OF ALL MATERIALS.

STRUCTURAL NOTES:

1. ALL EXPOSED CONCRETE EDGES SHALL BE CHAMFERED 3/4 INCH.
2. INDICATED REINFORCED BAR SPACING IS CENTER TO CENTER OF BARS. BAR COVER IS CLEAR DISTANCE BETWEEN SURFACE OF BAR AND FACE OF CONCRETE, AND SHALL BE 2 INCHES FOR FORMED AND TOP SURFACES, AND 3 INCHES FOR SURFACES POURED AGAINST EARTH, UNLESS OTHERWISE SHOWN.
3. IN SECTIONS SHOWING A SINGLE MAT OF REINFORCING, THE STEEL SHALL BE POSITIONED IN THE CENTER OF THE SECTION UNLESS OTHERWISE SHOWN.
4. ALL BAR SPICES NOT SHOWN ON THE DRAWINGS SHALL BE STAGGERED WITH BARS LAPPING A MINIMUM OF 30 BAR DIAMETERS OF THE SMALLER BAR BEING SPICED.
5. ALL BAR BENDING DIMENSIONS ARE OUT TO OUT OF THE BAR.
6. ALL CONCRETE SHALL BE CLASS 4,000 (4,000 P.S.I. COMPRESSIVE STRENGTH AT 28 DAYS). EXCEPT MASS CONCRETE IN OGEE CREST WHICH SHALL BE CLASS 3,500 (3,500 P.S.I. COMPRESSIVE STRENGTH AT 28 DAYS).
7. WELDED SMOOTH WIRE FABRIC FOR GUARD DUE CONCRETE REINFORCEMENT SHALL CONFORM TO ASTM A 185.



0 9 18 27
MILES

GENERAL LOCATION MAP



SHEET INDEX-LOCATION MAP

COONEY DAM REHABILITATION
CARBON COUNTY, MONTANA

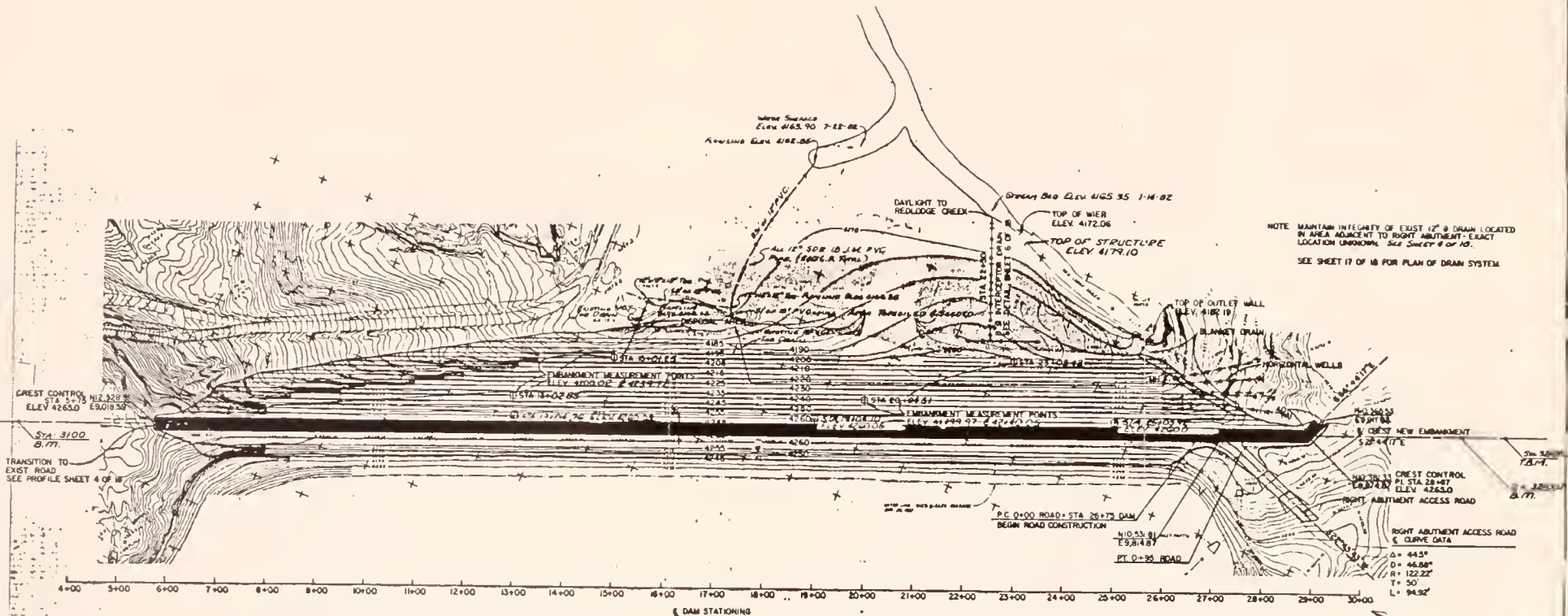
DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION, ENGINEERING BUREAU

DESIGNED BY: RJP DATE: 9-19-81
DRAWN BY: S.E. DATE: 4-14-82
APPROVED BY: RJP TITLE: ENG. DATE: 9-23-81
SHEET NO. 1 OF 18

As BUILT - 1982

PREPARED BY: HMM ASSOCIATES JOB #BMO87 107

5-64-33



CONTROL AND BENCHMARK ELEVATION POINTS

Station	Offset	Elevation	Point	Remarks	Description
3+00.0	on centerline	4271.99	13,794.4	8,915.7	N.M. top rebar in dam.
13+03.4	45.35 LT.	4239.73	13,874.2	9,348.4	Top rebar in dam.
13+05.5	24.49 LT.	4240.83	11,859.9	9,312.1	Top rebar in dam.
15+02.1	144.39 LT.	4200.03	11,721.2	9,494.9	Top rebar in dam.
19+04.9	24.39 LT.	4240.05	11,383.7	9,523.9	Top rebar in dam.
20+05.2	44.57 LT.	4240.69	11,234.5	9,409.2	Top rebar in dam.
23+04.2	145.30 LT.	4199.87	10,874.5	9,784.8	Top rebar in dam.
25+04.6	25.47 LT.	4240.00	10,745.9	9,754.9	Top rebar in dam.
32+93.5	69.35 LT.	4254.84	None	None	T.B.M. 3-31-1 rebar 4 cap in 10x10 10'x10' south of pine tree
32+00.1	on centerline	4270.20	10,090.3	9,999.8	N.M. top rebar in dam.
31+99.3	on centerline	4271.62	None	None	T.B.M. rebar

PLAN OF DAM

COONEY DAM REHABILITATION
CARBON COUNTY, MONTANA

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION, ENGINEERING BUREAU



DESIGNED BY: D.L.D. DATE: 8-24-82

DRAWN BY: B.D.M. DATE: 4-27-88

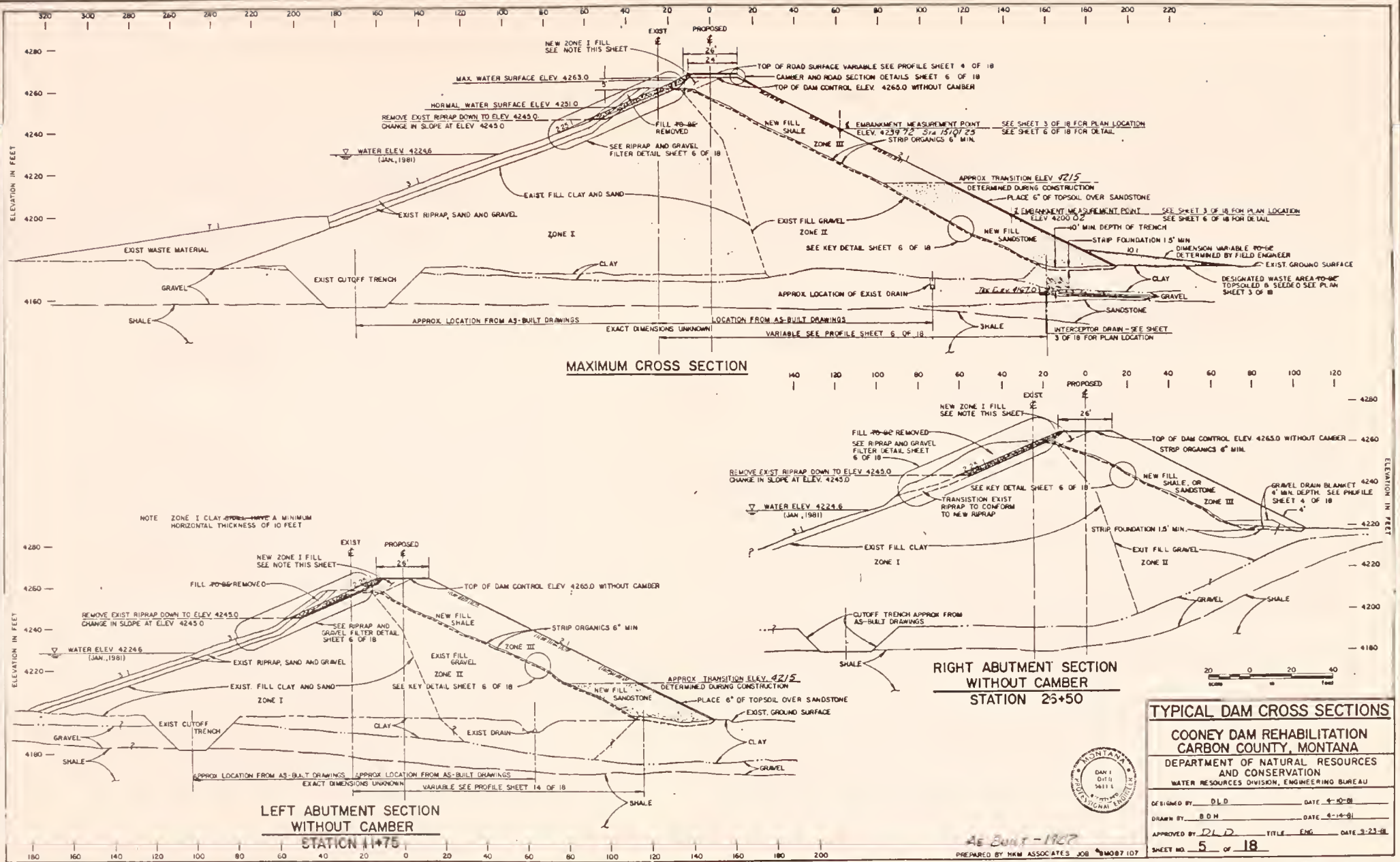
APPROVED BY: D.L.D. TITLE: ENR. DATE: 3-23-88

SHEET NO. 3 OF 18

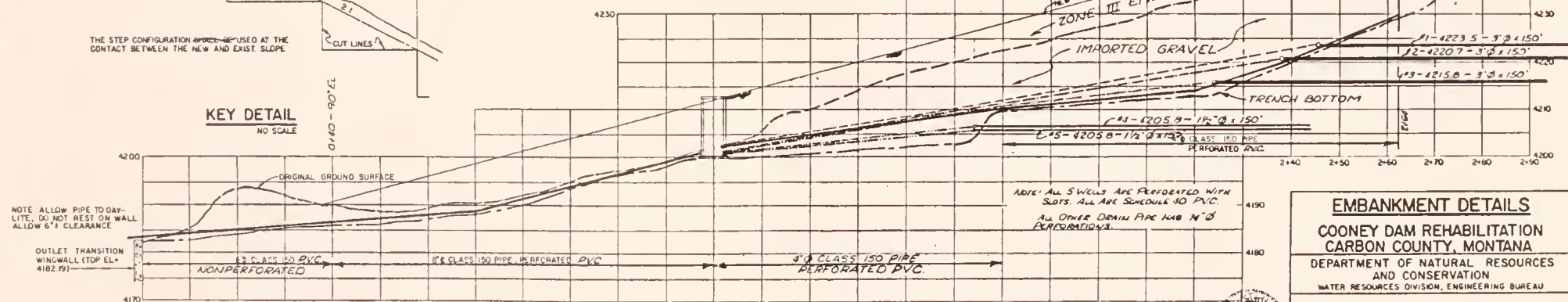
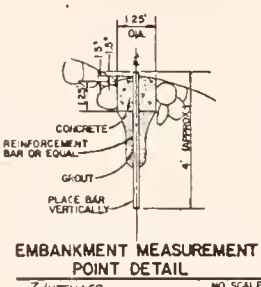
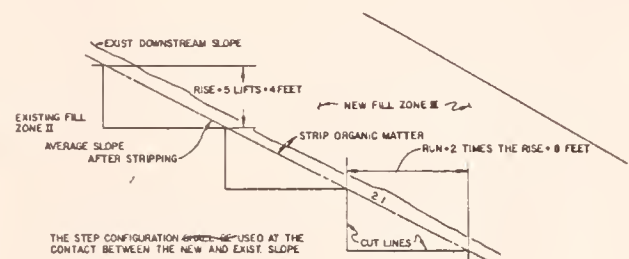
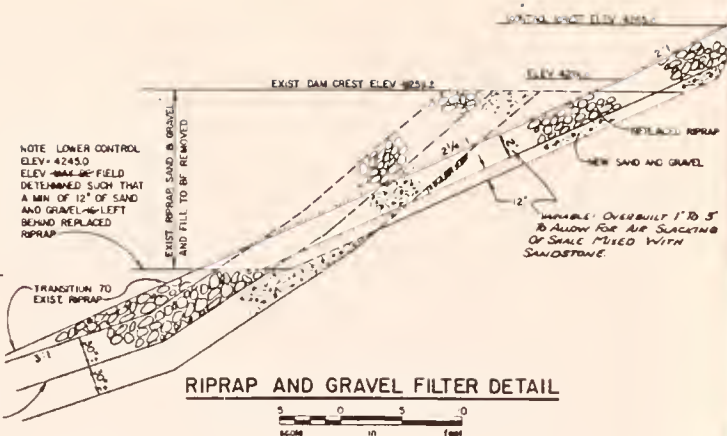
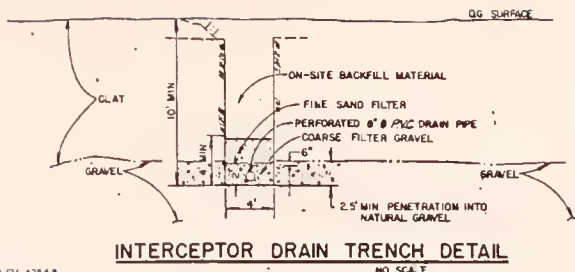
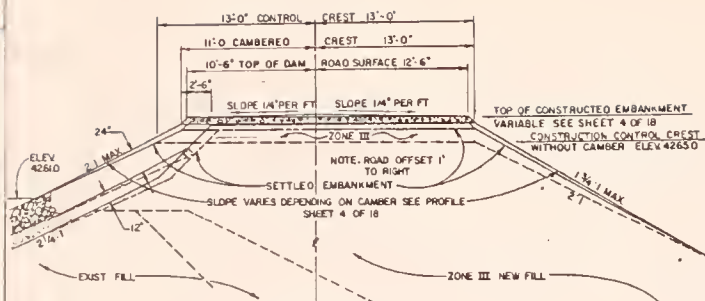
As Built - 1982

PREPARED BY HKM ASSOCIATES JOB #M087107

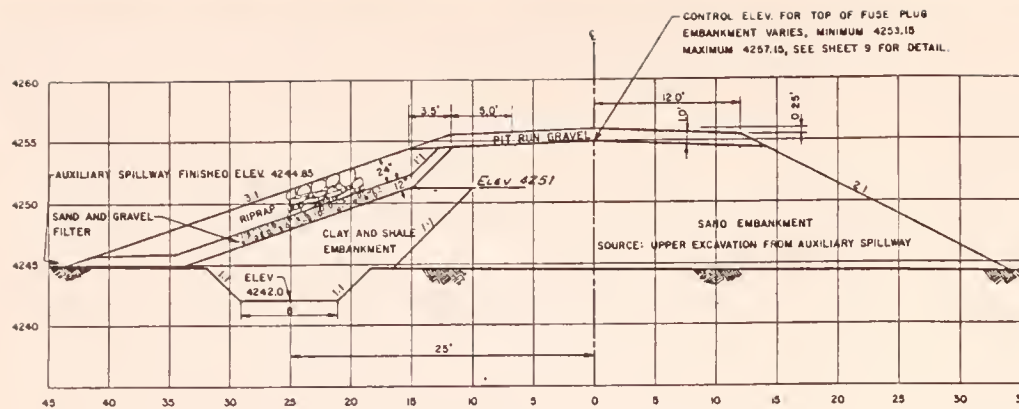
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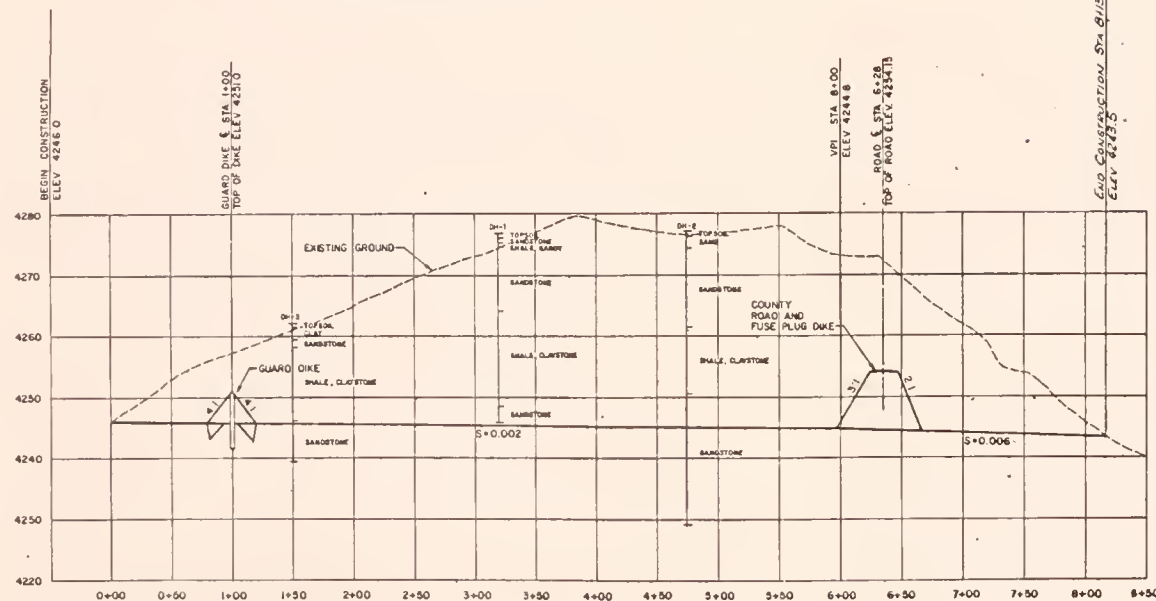
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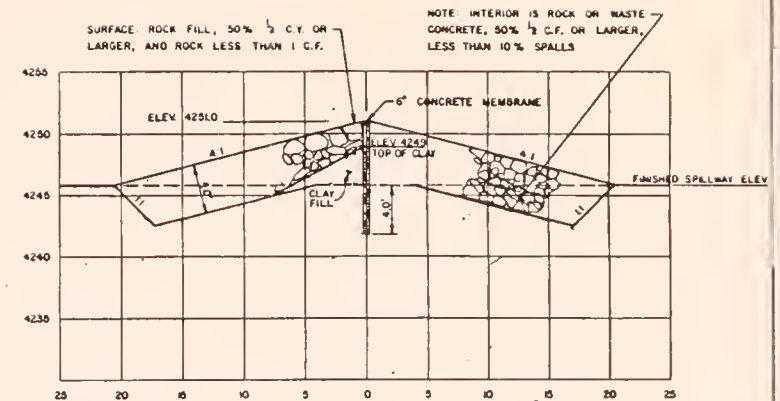
EMBANKMENT DETAILS			
COONEY DAM REHABILITATION			
CARBON COUNTY, MONTANA			
DEPARTMENT OF NATURAL RESOURCES			
AND CONSERVATION			
WATER RESOURCES DIVISION, ENGINEERING BUREAU			
DESIGNED BY: D.L.D.	DATE: 4-19-81		
DRAWN BY: B.O.M.	DATE: 4-27-81		
APPROVED BY: D.L.D.	TITLE: EMB	DATE: 5-22-81	
SHEET NO. 6		OF 18	



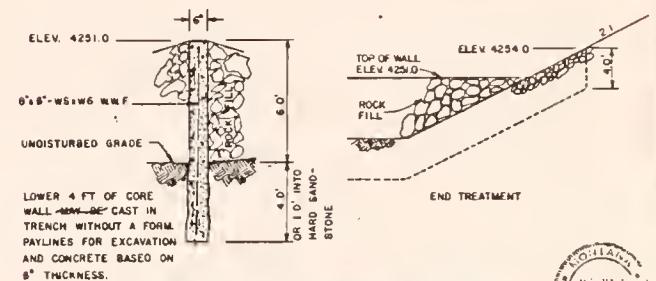
ROAD AND FUSE PLUG DIKE
TYPICAL SECTION A-A



AUXILIARY SPILLWAY PROFILE C



GUARD DIKE
TYPICAL SECTION B-B



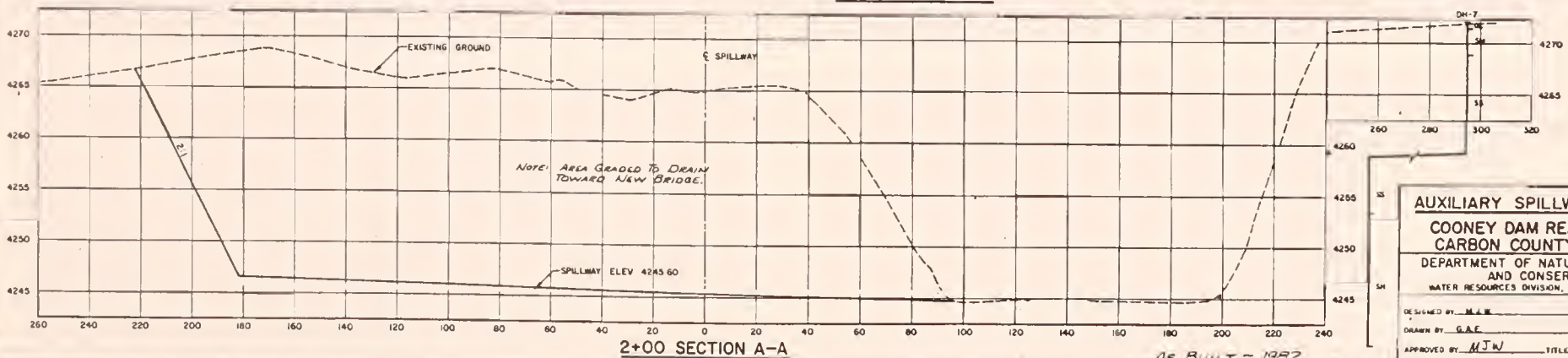
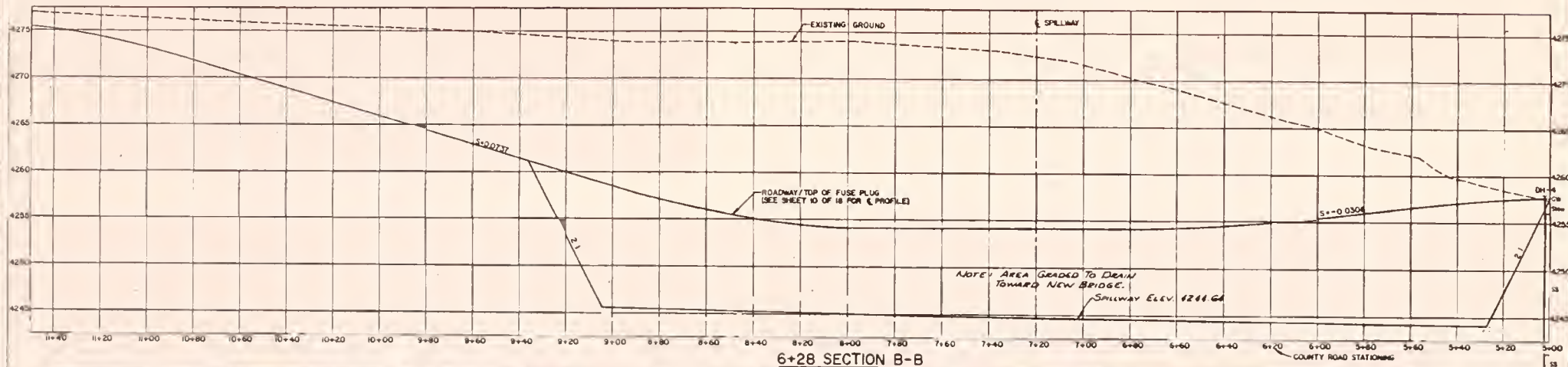
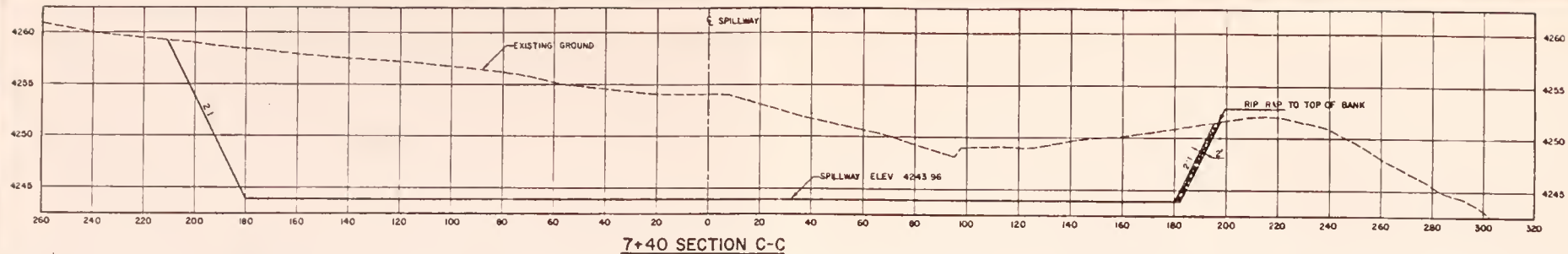
GUARD DIKE MEMBRANE DETAILS
NO SCALE

AUXILIARY SPILLWAY
PROFILE AND SECTIONS
COONEY DAM REHABILITATION
CARBON COUNTY, MONTANA
DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION, ENGINEERING BUREAU

DESIGNED BY: M.J.W. DATE: 4-20-81
DRAWN BY: G.B.E. DATE: 4-21-81
APPROVED BY: M.J.W. TITLE: E.M.G. DATE: 4-23-81
SHEET NO. 8 OF 18

As Built - 1982
PREPARED BY: NKW ASSOCIATES JOB #BMOB7107

5-64-40



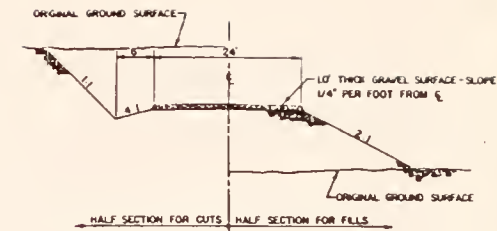
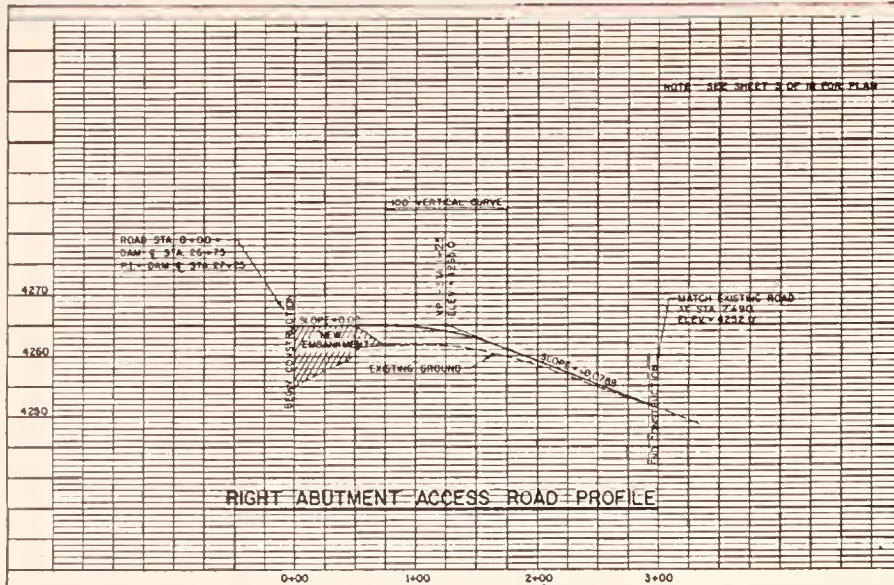
AS BUILT - 1982

PREPARED BY: HNM ASSOCIATES W.D. #0807.07

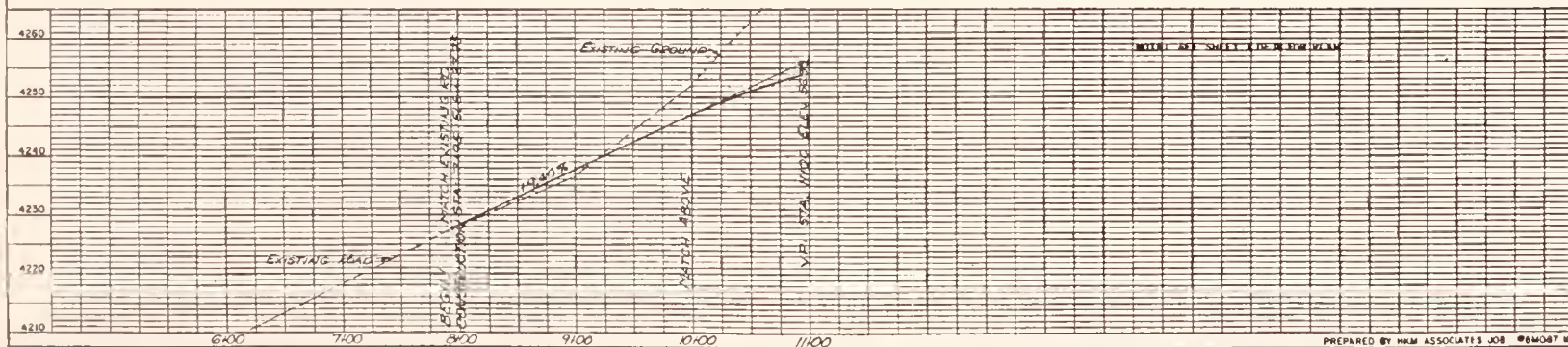
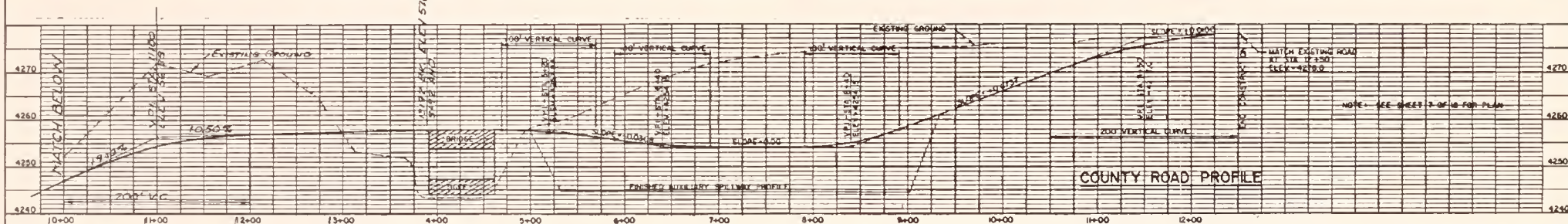
AUXILIARY SPILLWAY SECTIONS
COONEY DAM REHABILITATION
CARBON COUNTY, MONTANA
 DEPARTMENT OF NATURAL RESOURCES
 AND CONSERVATION
 WATER RESOURCES DIVISION, ENGINEERING BUREAU

DESIGNED BY: M.A.B. DATE: 9-21-81
 DRAWN BY: G.A.E. DATE: 4-22-82
 APPROVED BY: M.J.W. TITLE: ENG. DATE: 9-23-81
 SHEET NO. 9 OF 18

5-64-41



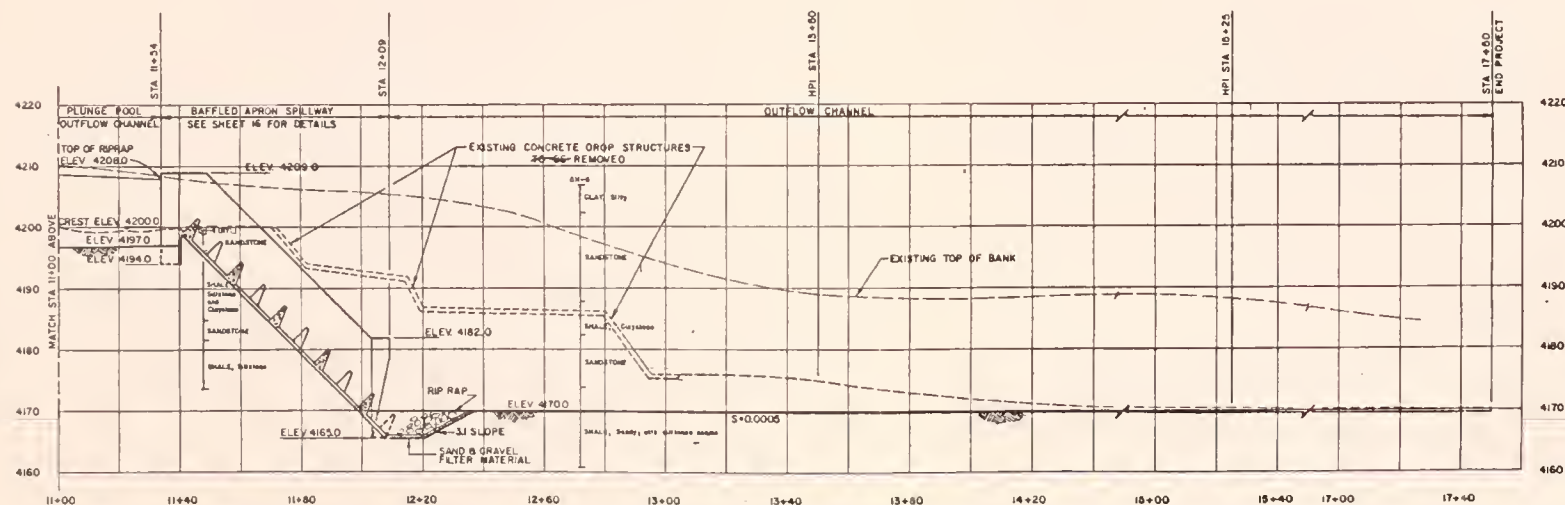
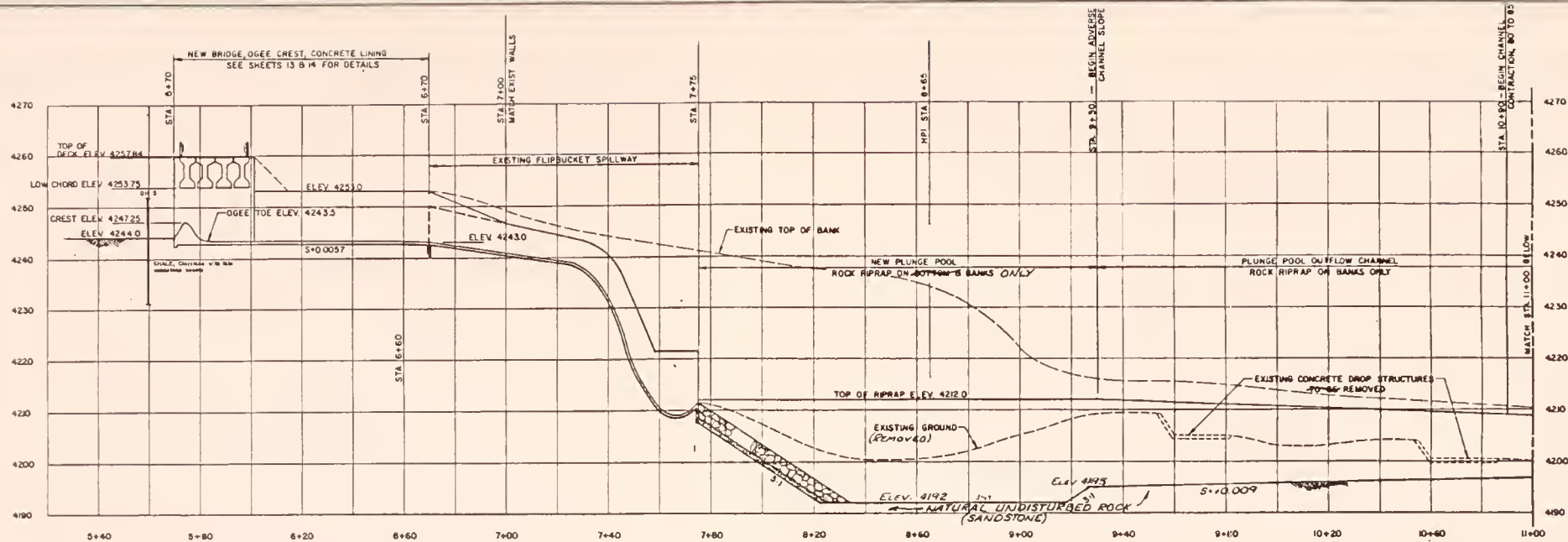
TYPICAL ROAD SECTION



DESIGNED BY: H.A.M. DATE: 5-23-81
 DRAWN BY: S.A.S. DATE: 5-30-81
 APPROVED BY: H.T.W. TITLE: ENG. DATE: 5-23-81
 SHEET NO. 10 OF 18

PREPARED BY: HMM ASSOCIATES JOB #84087 107
 As Built - 1992

5-44-42



NOTES:
1. DRILL HOLE STATIONS ARE APPROXIMATE



PRINCIPAL SPILLWAY PROFILE

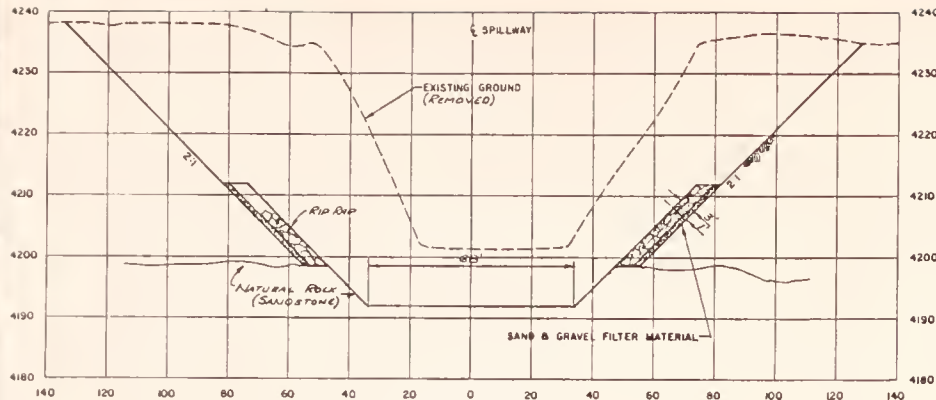
COONEY DAM REHABILITATION
CARBON COUNTY, MONTANA

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION, ENGINEERING BUREAU

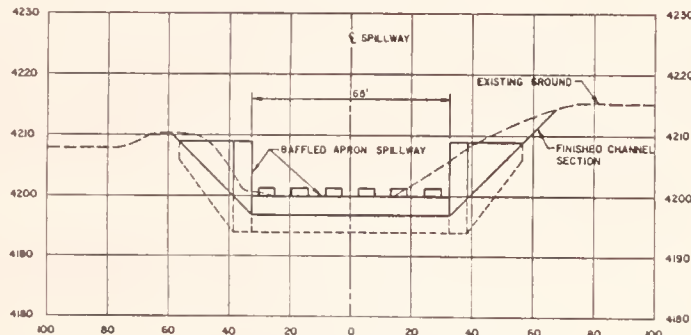
DESIGNED BY: M.J.W. DATE: 4-22-81
DRAWN BY: G.A.E. DATE: 5-22-81
APPROVED BY: M.J.W. TITLE: ENG. DATE: 5-23-81
SHEET NO. 11 OF 18

As Built - 1982
PREPARED BY: HRM ASSOCIATES JOB #BMO87.107

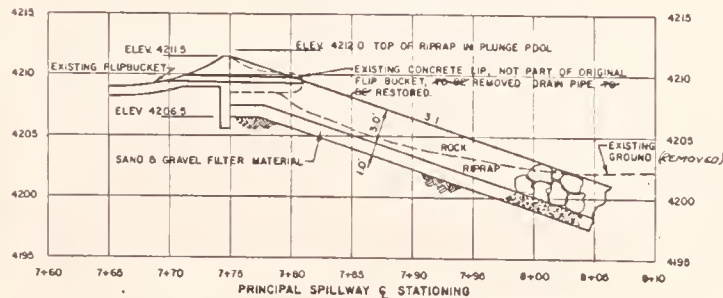
5-64-43



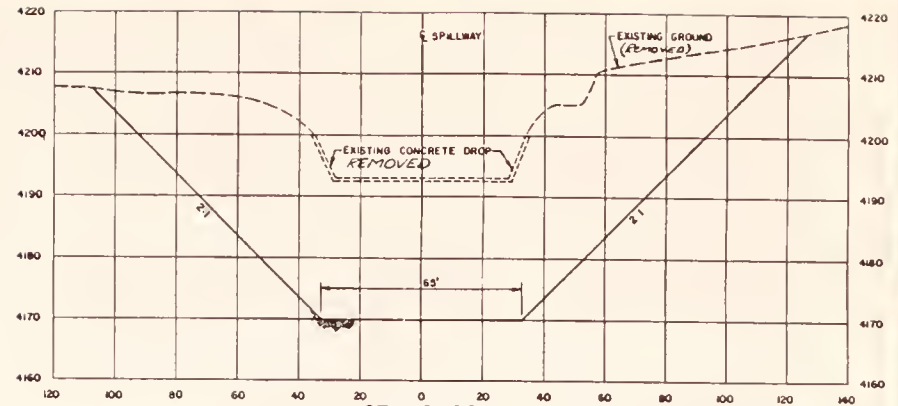
STA. 8+25
SECTION A-A



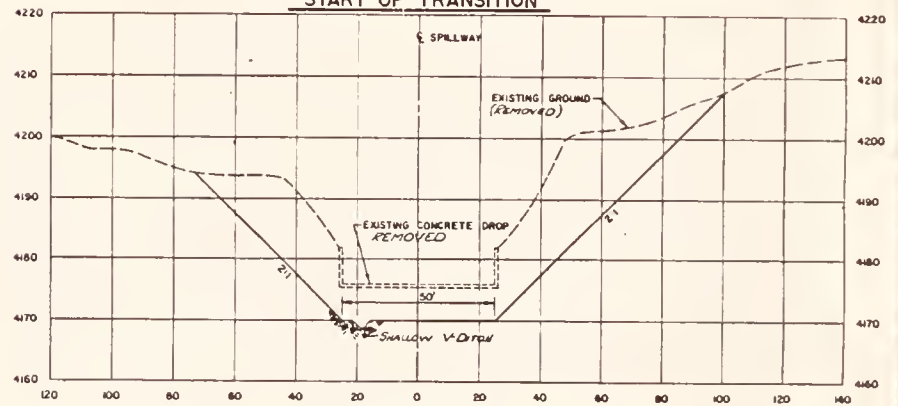
BAFFLED APRON SPILLWAY INLET
SECTION B-B



DETAIL - FLIPBUCKET END TREATMENT



STA. 12+00
OUTLET CHANNEL
SECTION C-C
START OF TRANSITION



STA. 13+00
OUTLET CHANNEL
SECTION D-D
END OF TRANSITION

NOTE: SEE PAGE 17 OF 18 FOR DETAIL OF TYPICAL CROSS SECTION OF CHANNEL BETWEEN PLUNGE POOL AND BAFFLED APRON DROP



TYPICAL PRINCIPAL
SPILLWAY CROSS SECTIONS
COONEY DAM REHABILITATION
CARBON COUNTY, MONTANA

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION, ENGINEERING BUREAU

DESIGNED BY: M.J.W. DATE: 9-23-81

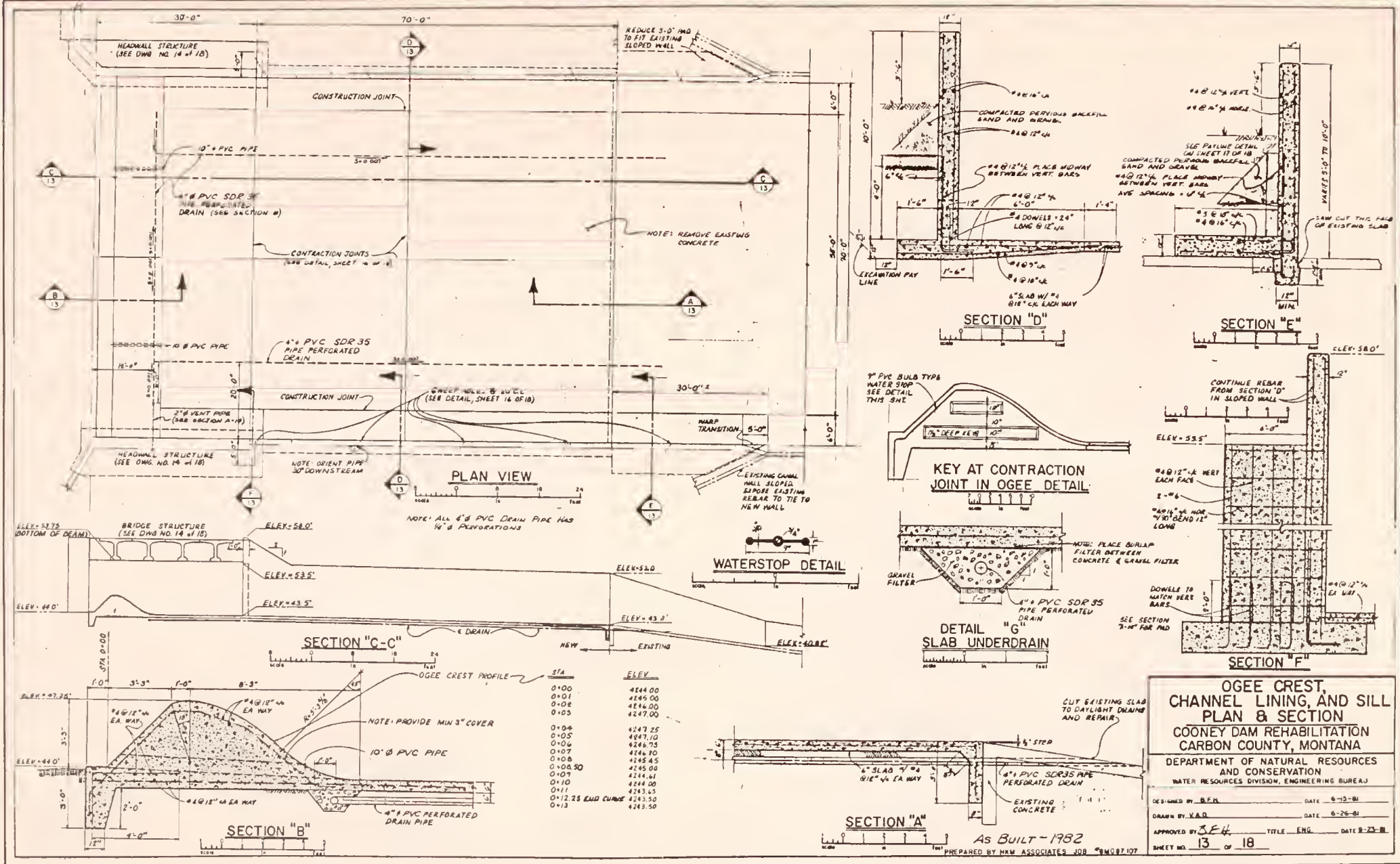
DRAWN BY: G.A.E. DATE: 9-23-81

APPROVED BY: M.J.W. TITLE: ENG. DATE: 9-23-81

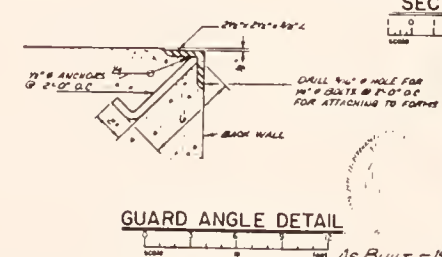
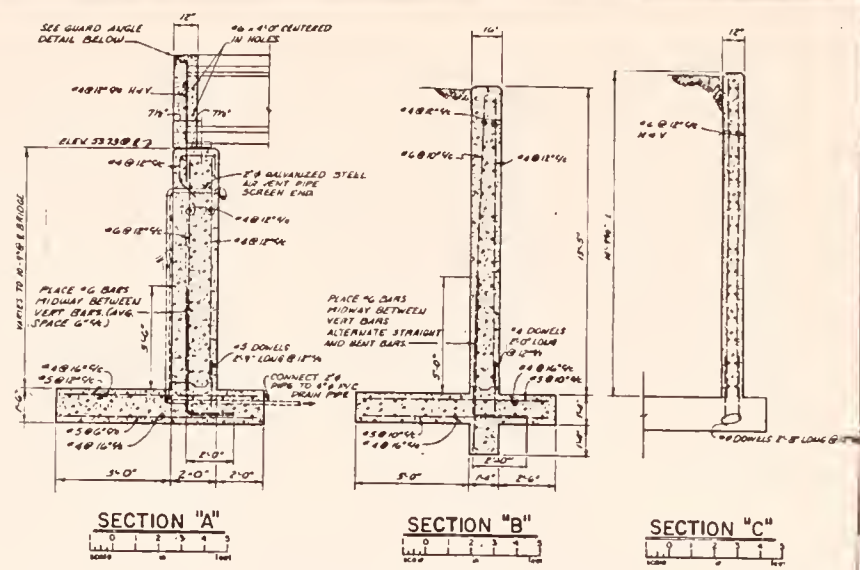
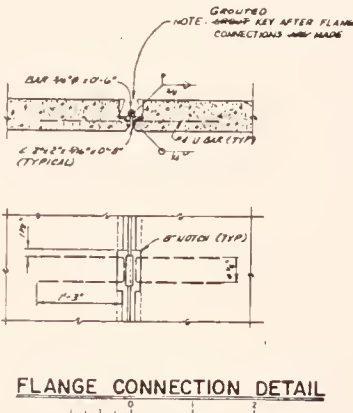
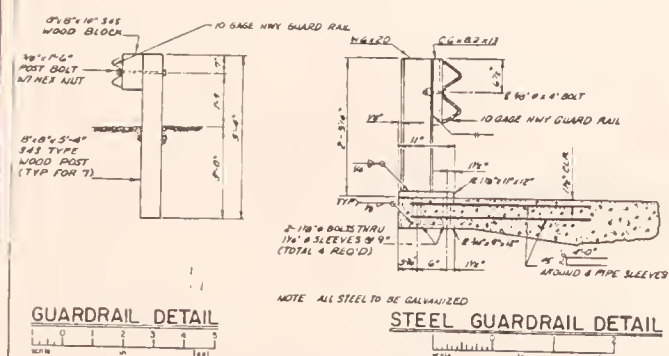
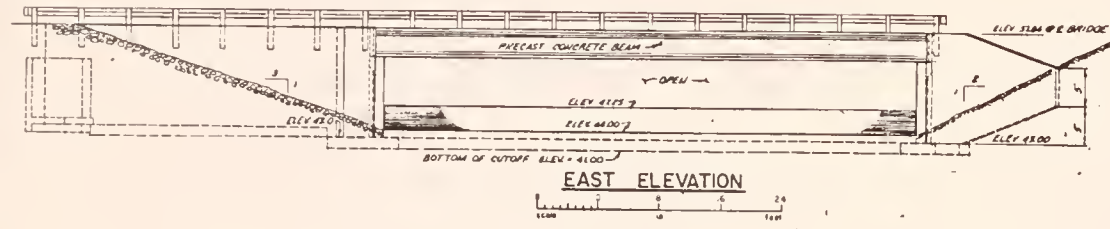
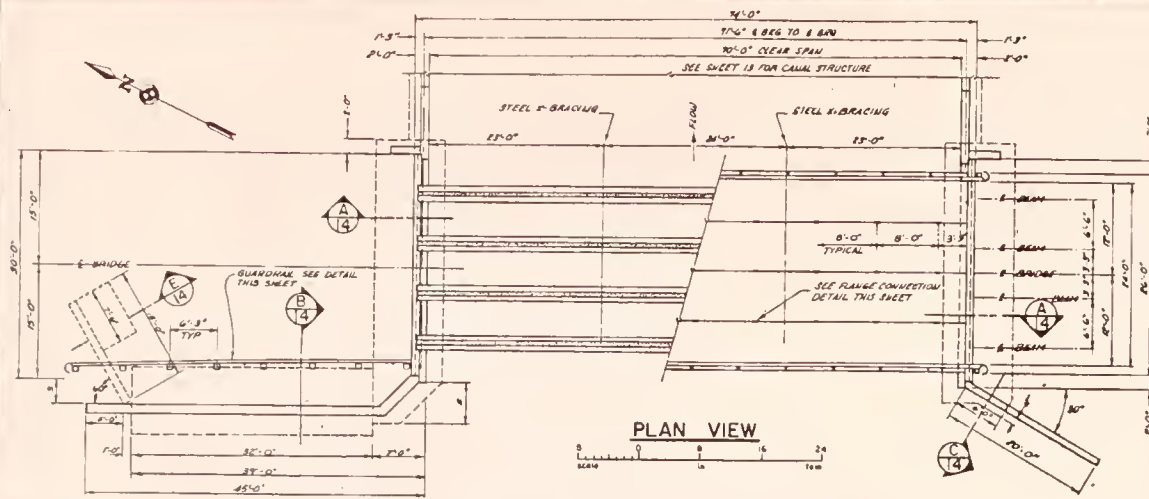
PREPARED BY: HKM ASSOCIATES JOB #84087 107

SHEET NO. 12 OF 18

5-64-44

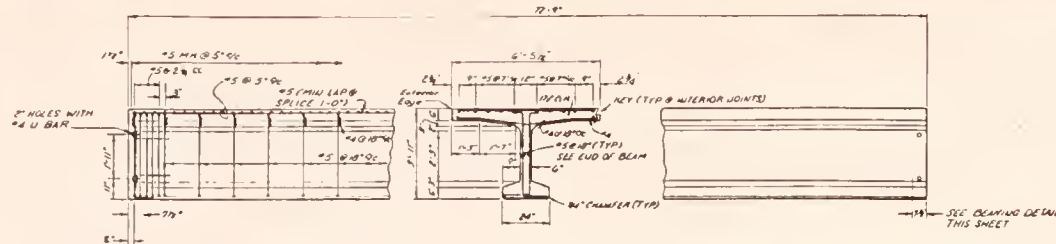


5464-40

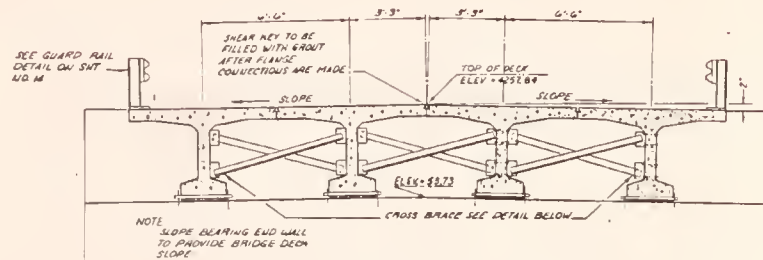


BRIDGE PLAN & PROFILE	
COONEY DAM REHABILITATION	
CARBON COUNTY, MONTANA	
DEPARTMENT OF NATURAL RESOURCES	
AND CONSERVATION	
WATER RESOURCES DIVISION, ENGINEERING BUREAU J	
DESIGNED BY B.F.H.	DATE 6-25-81
DRAWN BY R.A.	DATE 6-30-81
APPROVED BY J.E.H.	TITLE ENG. DATE 2-23-82
SHEET NO. 14 OF 18	

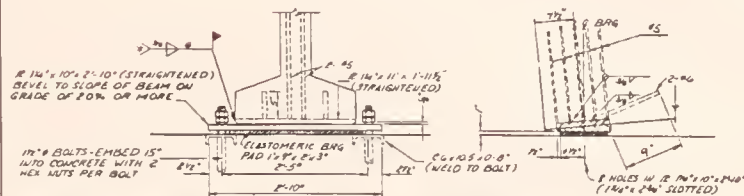
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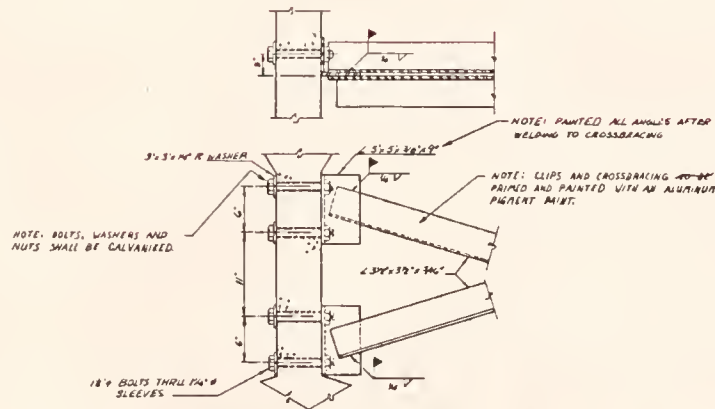
BEAM ELEVATION



BRIDGE CROSS-SECTION



BEARING DETAILS

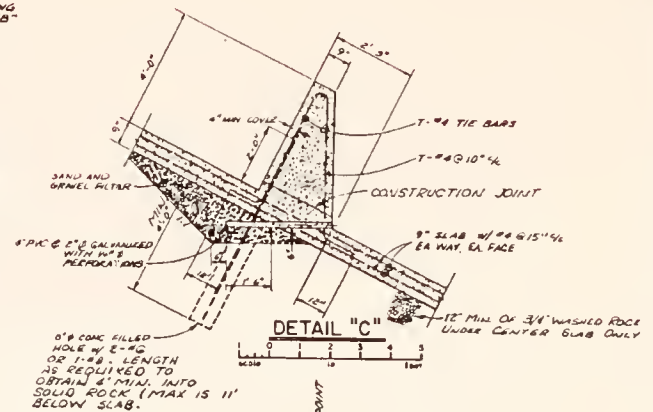
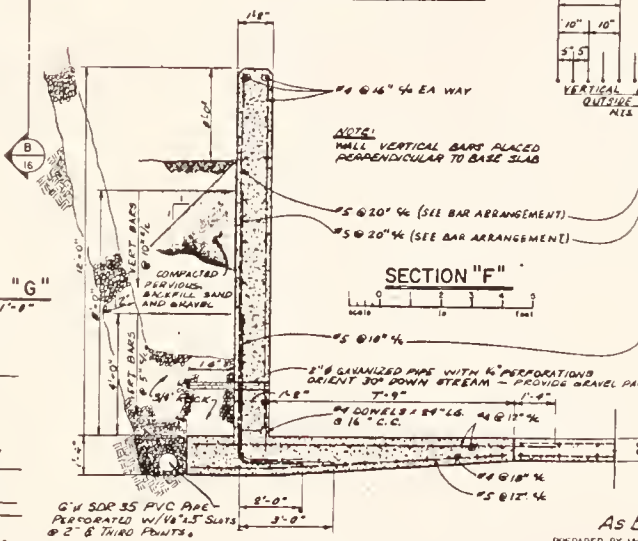
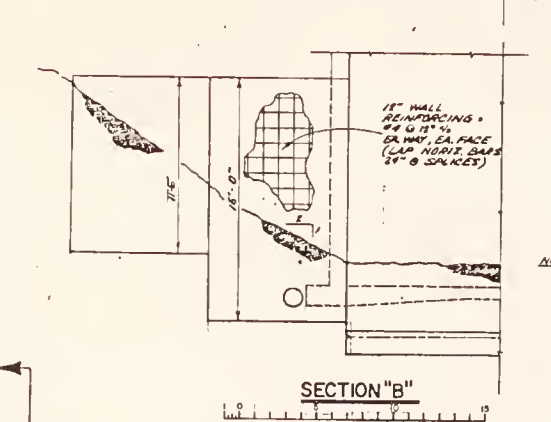
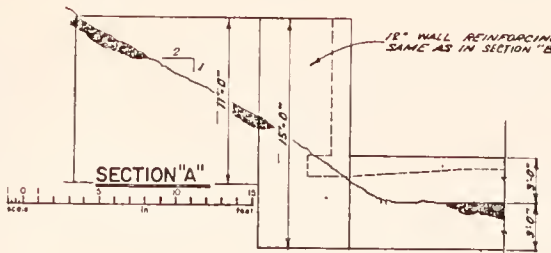
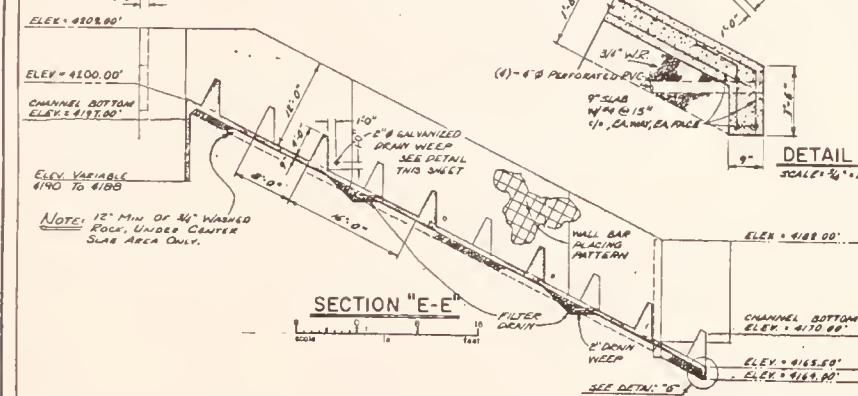
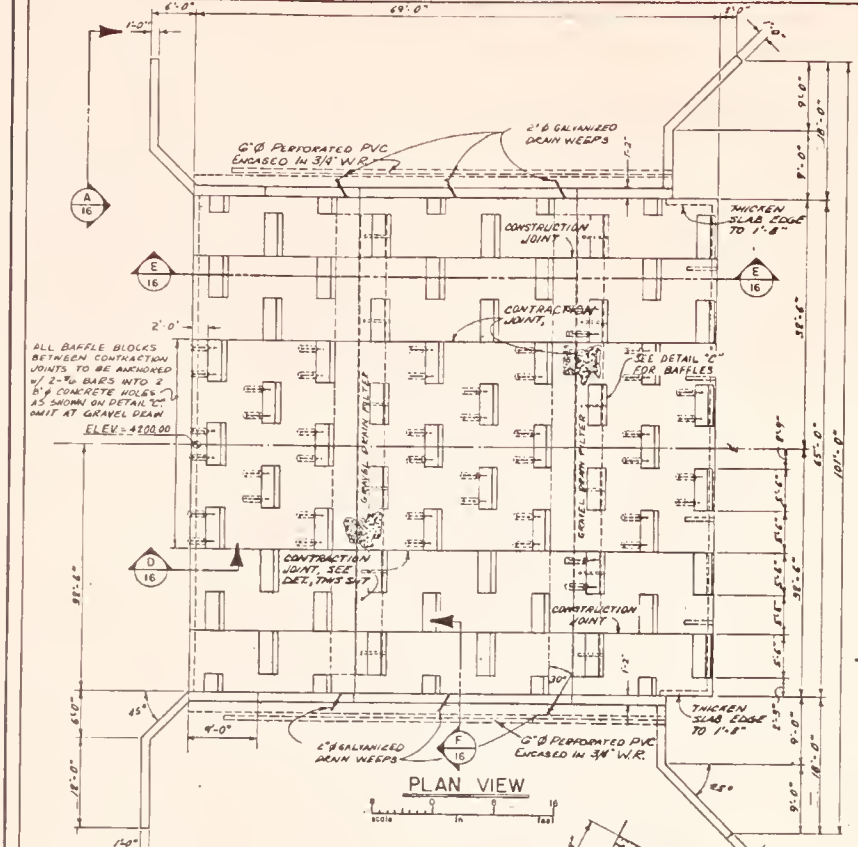


CROSS BRACING DETAIL

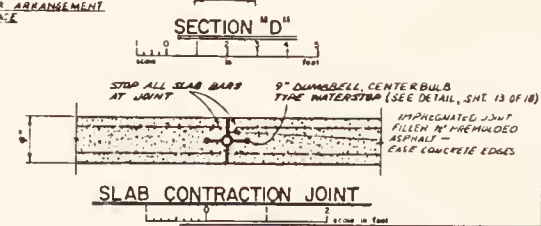
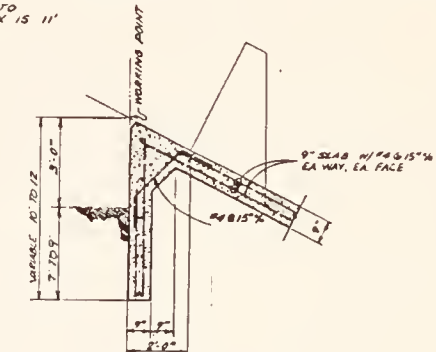
BRIDGE DETAILS			
COONEY DAM REHABILITATION			
CARBON COUNTY, MONTANA			
DEPARTMENT OF NATURAL RESOURCES			
AND CONSERVATION			
WATER RESOURCES DIVISION, ENGINEERING BUREAU			
DESIGNED BY	B.F.H.	DATE	6-25-81
DRAWN BY	R.A.	DATE	6-30-81
APPROVED BY	R.F.H.	TITLE	ENG.
SHEET NO.	15	OF	18

As BUILT - 1982
PREPARED BY HMM ASSOCIATES JOB #8MOB107

5-64-47



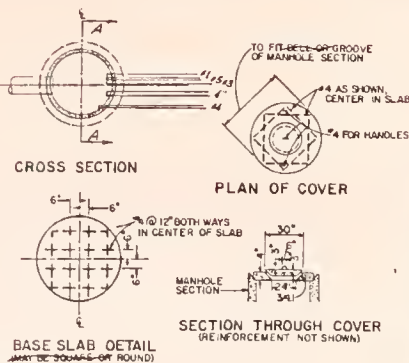
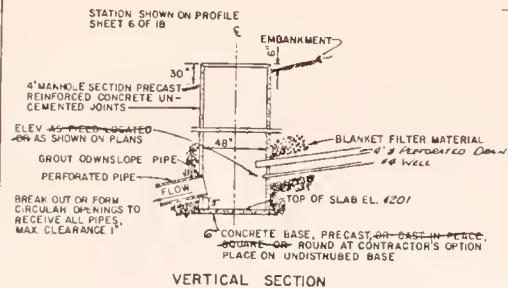
NOTE: BAFFLES NOT SHOWN FOR CLARITY



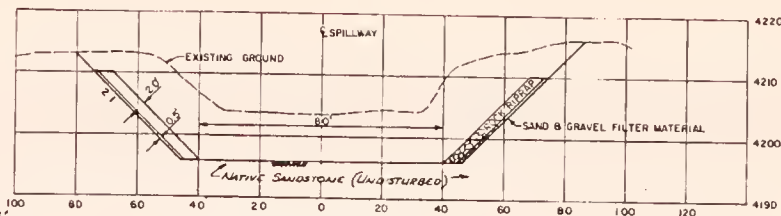
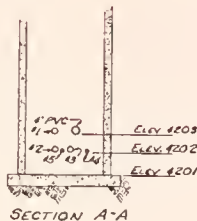
BAFFLED DROP-STRUCTURAL DETAILS	
COONEY DAM REHABILITATION	
CARBON COUNTY, MONTANA	
DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION	
WATER RESOURCES DIVISION, ENGINEERING BUREAU	
DESIGNED BY: B.F.H.	DATE: 6-18-81
DRAWN BY: B.F.H.	DATE: 6-22-81
APPROVED BY: R.E.H.	TITLE: ENG. DATE: 9-23-81
SHEET NO. 16 OF 18	

As BUILT - 1982
PREPARED BY H&M ASSOCIATES JOB #BWPRT.107

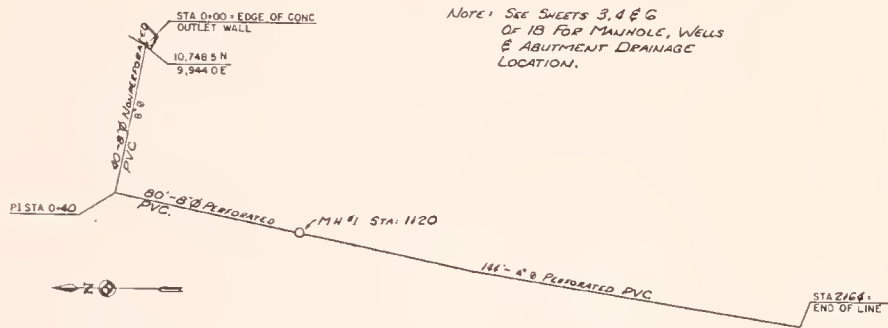
5-64-48



MANHOLE DETAILS
NO SCALE



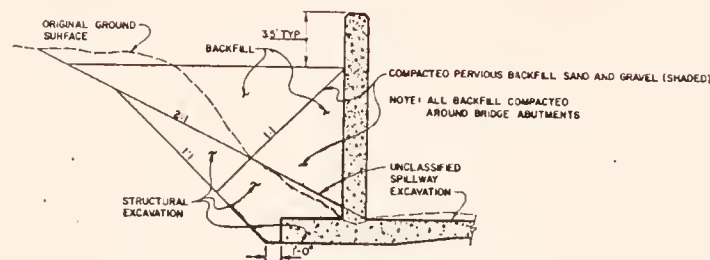
STA 10+25
PRINCIPAL SPILLWAY
TYPICAL CROSS SECTION



SEE SHEET 6 OF 18 FOR PROFILE OF
HORIZONTAL WELL MANIFOLD SYSTEM

PLAN
HORIZONTAL WELL MANIFOLD SYSTEM

NOTE: SEE SHEETS 3, 4 & 6
OF 18 FOR MANHOLE, WELLS
& ABUTMENT DRAINAGE
LOCATION.



TYPICAL PAYLINES
FOR EARTHWORK
NO SCALE

MISCELLANEOUS DETAILS
COONEY DAM REHABILITATION
CARBON COUNTY, MONTANA

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION, ENGINEERING BUREAU

DESIGNED BY: M.J.W. DATE: 5-29-81

DRAWN BY: H.A.G. DATE: 5-29-81

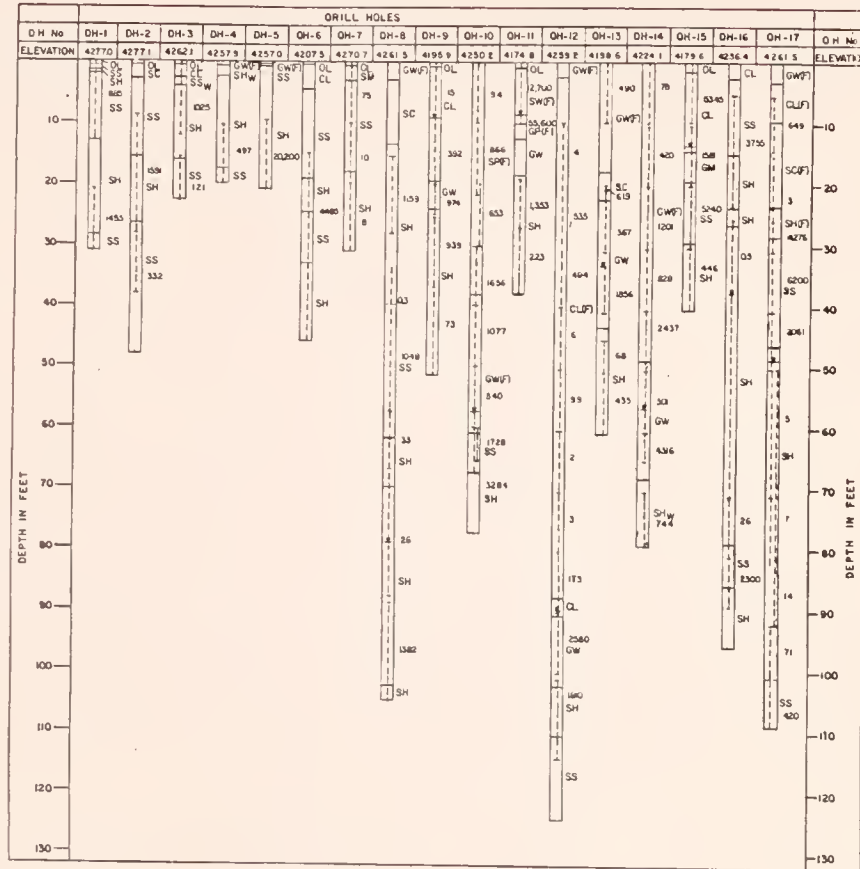
APPROVED BY: R.P. M.W. TITLE: ENG. DATE: 8-23-81

SHEET NO. 17 OF 18

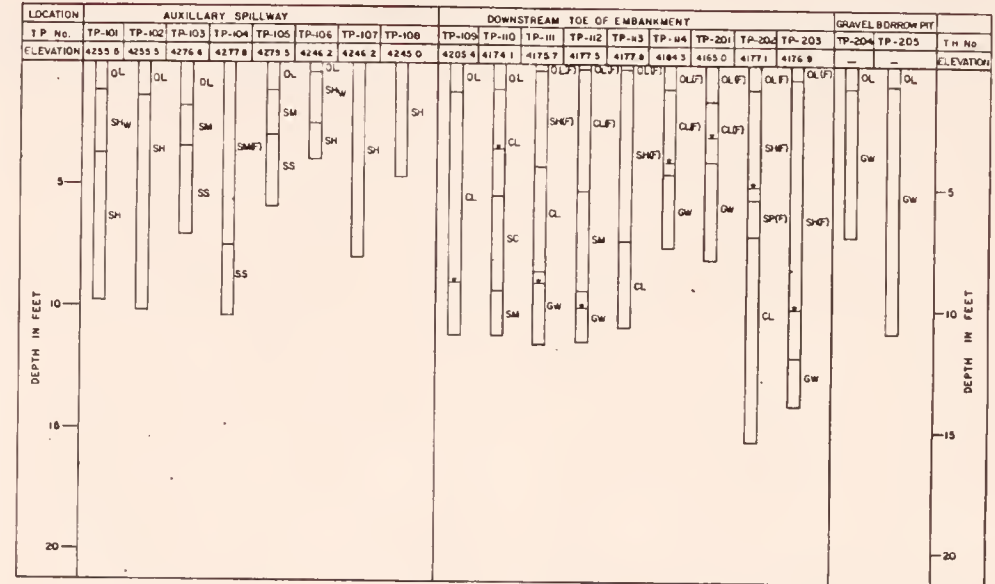
As BUILT - 1982
PREPARED BY: H.M. ASSOCIATES FOR "SHORT 107"

5-64-49

BORING LOGS



TEST PIT EXCAVATIONS



NOTES

1. CLASSIFICATION IS IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM.
2. ALL SOIL LOGS SHOWN ARE ABRIDGED. COMPLETE DRILLING LOGS, LABORATORY REPORTS, AND GEOLOGY REPORTS ARE AVAILABLE FOR RIGIDERS INSPECTION AT THE ENGINEER'S OFFICE IN BILLINGS, MONTANA.
3. Δ DENOTES WATER LEVEL AS MEASURED IN THE FIELD AT THE DATE OF LOGGING. DEPTH TO WATER TABLE WAS NOT LOGGED IN ALL HOLES.
4. SOME TEST PIT LOCATIONS ARE OFFSET OF $\frac{1}{2}$ FOR LOCATION SEE PLAN OF DAM AND RESERVOIR, SHEET 3.

BORING LEGEND

- CL CLAY; LOW TO MEDIUM PLASTICITY, SILTY
- GC SANDY OR GRAVELLY CLAYS AND CLAYEY SILTS
- GM GRAVEL; CLAYEY; GRAVEL-SAND-CLAY MIXTURES
- GP GRAVEL; SILTY; GRAVEL-SAND-SILT MIXTURES
- GW GRAVEL; POORLY GRADED, SAND MIXED, FEW FINES
- SH SAND; WELL GRADED
- AL SILT; VERY FINE SANDS, SANDY OR CLAYEY SILTS
- OL ORGANIC CLAYS OR SILTS OF MEDIUM PLASTICITY, TOPSOIL
- SC SAND, CLAYEY; POORLY GRADED SAND CLAY MIXTURES
- SM SAND, SILTY; SAND SILT MIXTURES
- SP SAND, GRAVELLY; POORLY GRADED, LITTLE OR NO FINES
- SW SAND; WELL GRADED
- SS SANDSTONE
- SW WEATHERED SANDSTONE
- SH SHALES; CLAYSTONE, SILTSTONE OR SANDY
- SH WEATHERED SHALES
- (P) DENOTES MATERIAL IS A FILL
- T LENGTH OF PERMEABILITY TEST SECTION
- 71 DENOTE PERMEABILITY IN FEET PER YEAR

As Built - 1982

PREPARED BY HMM ASSOCIATES JOB #04087 107

EXPLORATION LOGS

COONEY DAM REHABILITATION
CARBON COUNTY, MONTANA

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION, ENGINEER NO BUREAU

DESIGNED BY DLD DATE 9-12-81

DRAWN BY F. F. BDN DATE 9-15-81

APPROVED BY DLD TITLE, FNG DATE 9-23-81

SHEET NO. 18 OF 18

5-64-30

